

Daily report

25-04-2020

## Analysis and prediction of COVID-19 for EU-EFTA-UK and other countries

## Foreword

The present report aims to provide a comprehensive picture of the **pandemic situation of COVID-19** in the EU countries, and to be able to foresee the situation in the next coming days.

We employ an **empirical model**, verified with the evolution of the number of confirmed cases in previous countries where the epidemic is close to conclude, including all provinces of China. The model does not pretend to interpret the causes of the evolution of the cases but to permit the **evaluation of the quality of control measures made in each state** and a **short-term prediction of trends**. Note, however, that the effects of the measures' control that start on a given day are not observed until approximately 7-10 days later.

The model and predictions are based on two parameters that are daily fitted to available data:

- ✓  $\alpha$ : the velocity at which spreading specific rate slows down; the higher the value, the better the control.
- ✓  $K$ : the final number of expected cumulated cases, which cannot be evaluated at the initial stages because growth is still exponential.

We show an individual report with 8 graphs and a table with the **short-term predictions** for different countries and regions. We are adjusting the model to **countries and regions** with at least 4 days with more than 100 confirmed cases and a current load over 200 cases. The **predicted period** of a country depends on the number of datapoints over this 100 cases threshold, and is of 5 days for those that have reported more than 100 cumulated cases for 10 consecutive days or more. For short-term predictions, we assign higher weight to last 3 points in the fittings, so that changes are rapidly captured by the model. The whole methodology employed in the inform is explained in the last pages of this document.

In addition to the individual reports, the reader will find an initial dashboard with a brief analysis of the situation in EU-EFTA-UK countries, some summary figures and tables as well as **long-term predictions** for some of them, when possible. These long-term predictions are evaluated without different weights to datapoints. We also discuss a specific issue every day.

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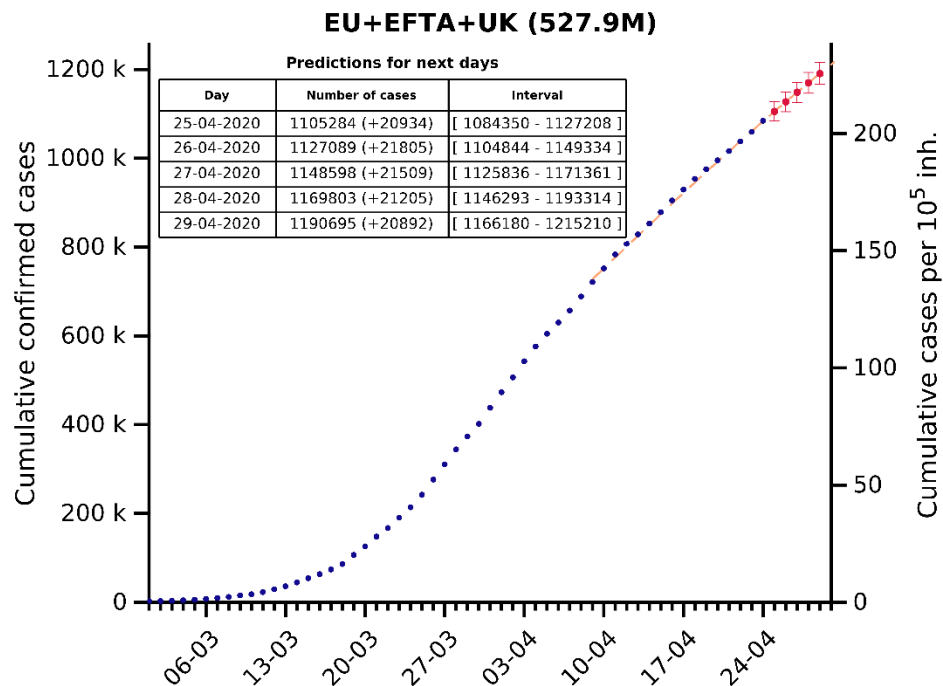


## **(0) Executive summary – Dashboard**

## Weekend short version

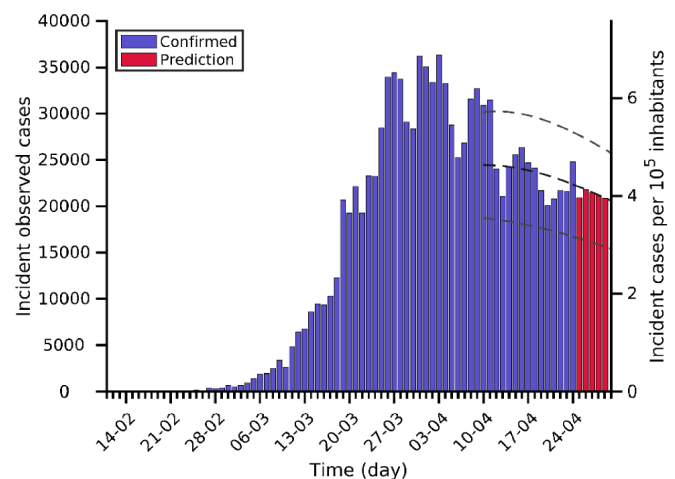
### Attack rate and short-term predictions in EU+EFTA+UK

Short-term predictions, based on last 15 points with increased weight on last 3:



### Highlights and/or warnings

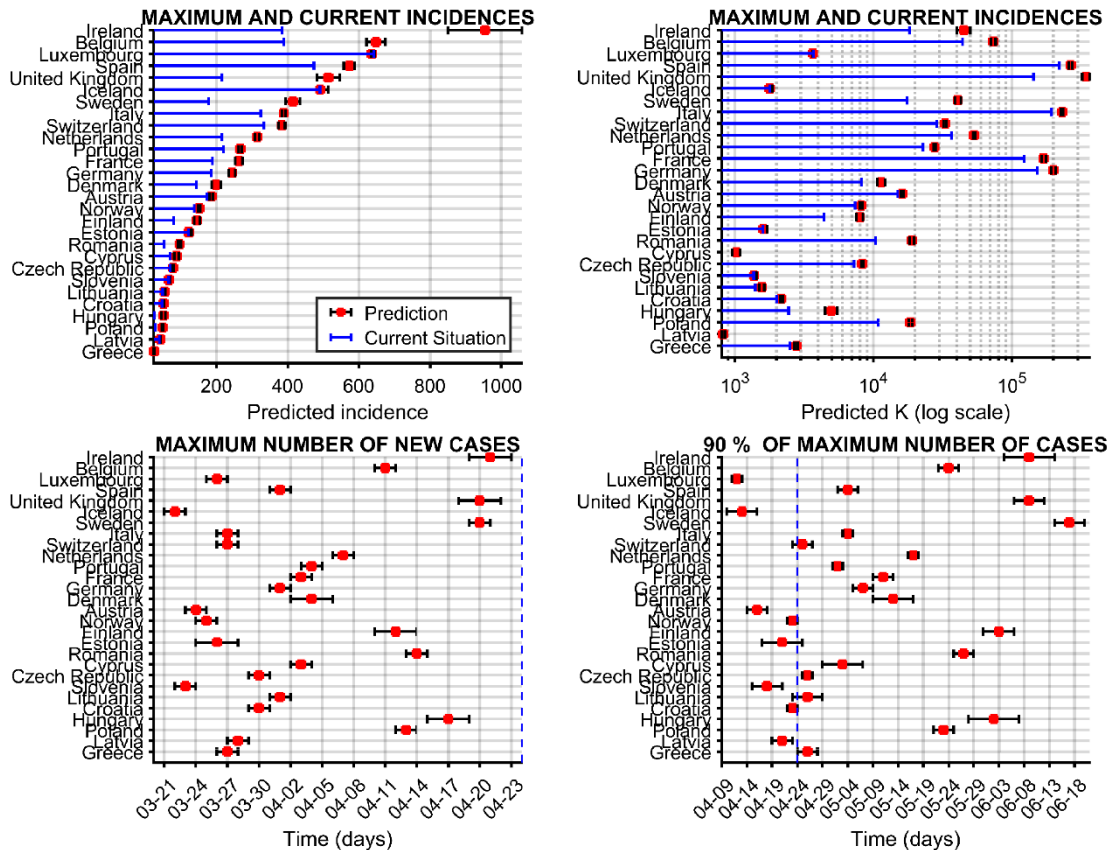
- EU+EFTA+UK countries present a sudden increase in new cases, with **4,000 more cases than expected** (see figure). The main reason is a sudden increase in Spain's data (6,740 new cases, in contrast with the values around 4,000 of the last days). This excess is caused by an increase in number of antibodies' tests. Total reported by this country (219,764 cases) does not distinguish between confirmed by PCR and diagnosed by antibodies' test. The later can provide positive result even for people that was sick a few weeks before.



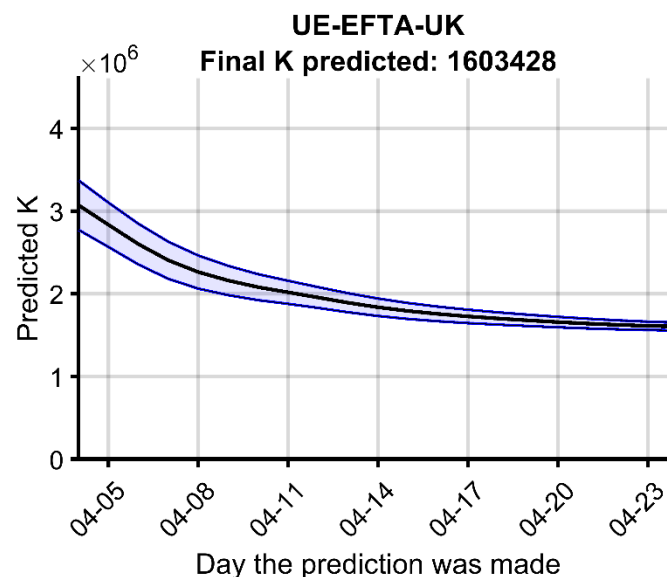
- In addition, three of the countries with highest incidence also present a sudden increase whose cause should be elucidated: **United Kingdom**, with an excess of 800 cases from those expected, **Belgium**, with an excess of 500 cases from those expected, and **Italy**, with an excess of 300.

## Long-term predictions

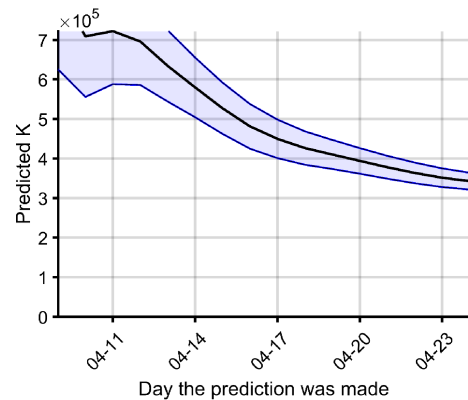
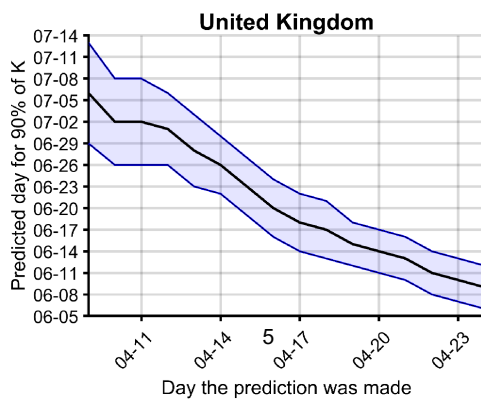
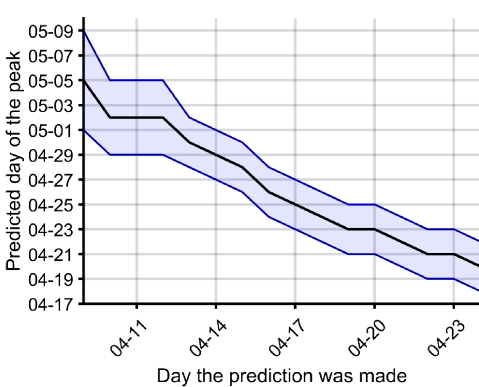
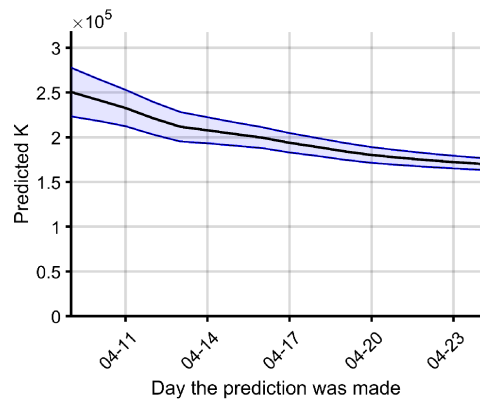
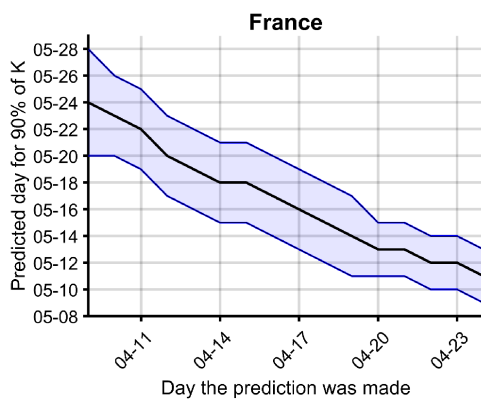
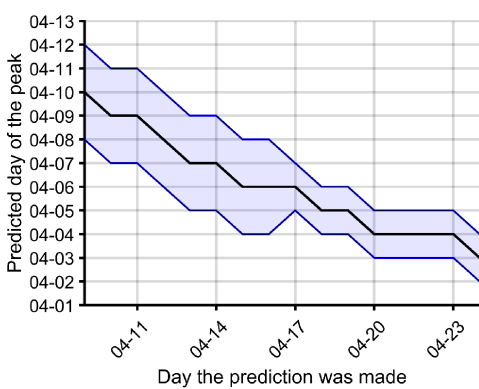
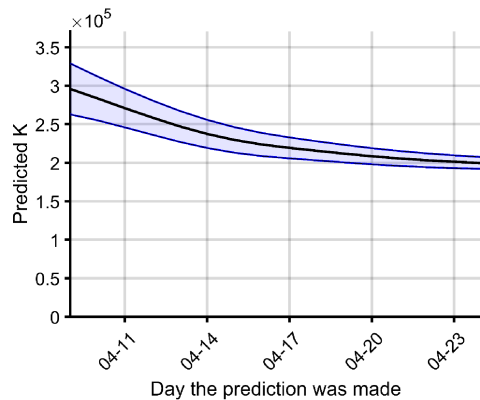
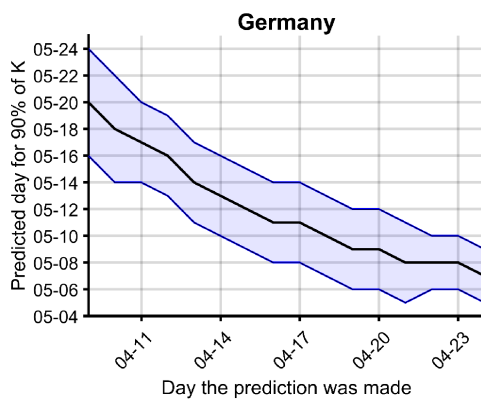
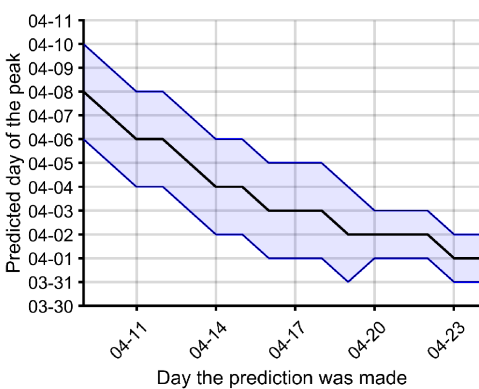
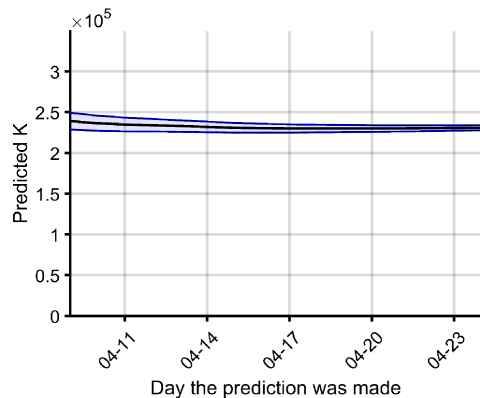
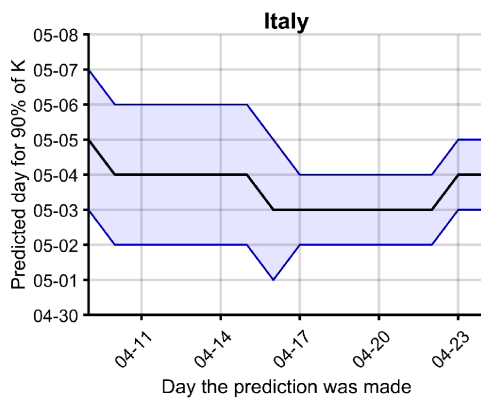
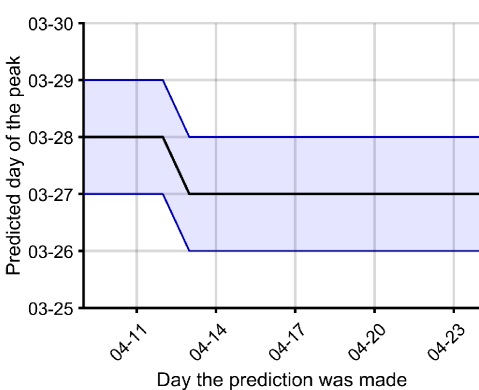
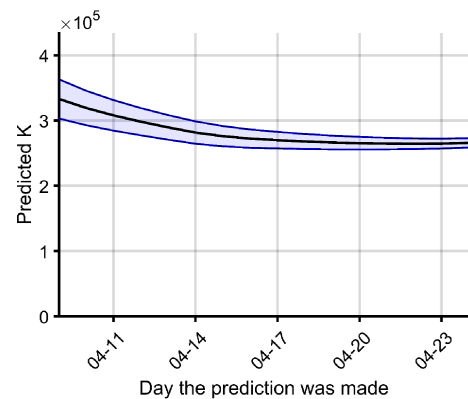
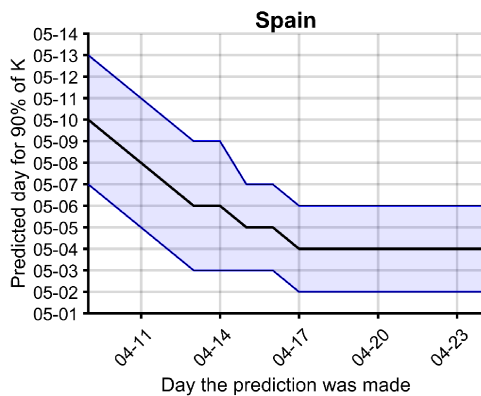
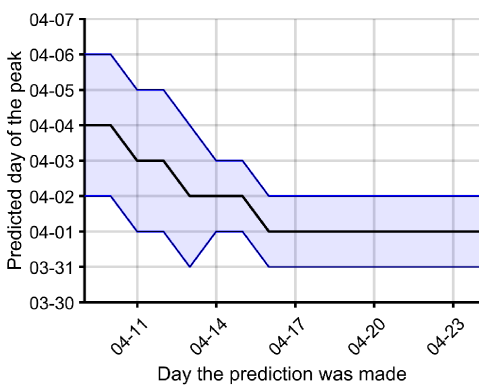
**Long-term predictions**, evaluated with the **whole historical series**. Up-left: Predictions of maximum incidences per country (total final expected attack rate per  $10^5$  inh.). Up-right: Predictions of maximum absolute number of cases per country (K, in log scale). Blue lines indicate current situation. Bottom-left: Time in which peak in new cases was achieved / will be achieved. Bottom-right: Time at which 90 % of K was achieved / will be achieved. Blue dotted line indicates current date.



**Final expected K for UE+EFTA+UK.** Evolution of predicted K with time, where convergence to best estimate is seen. Last prediction is numerically shown.



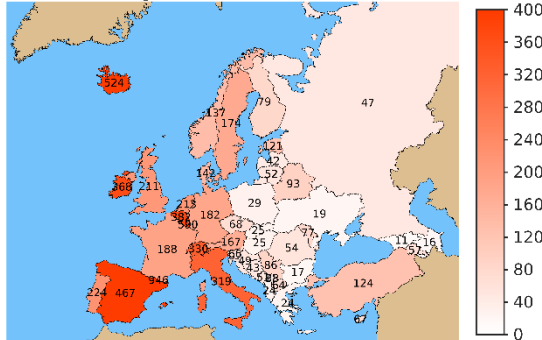
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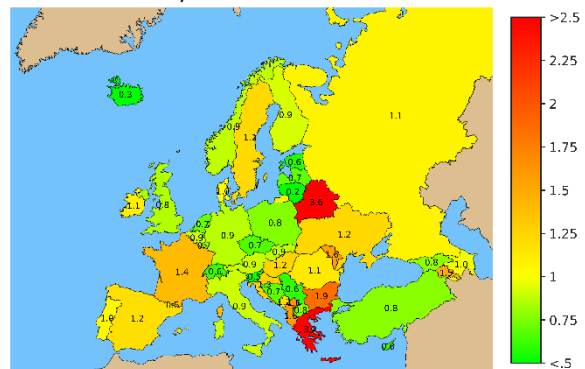
## Situation and trends per country

### Maps of current incidence and $\rho$

Incidence per 10<sup>5</sup> inh. 25-04-2020



$\rho$  24-04-2020



**Table of current situation in EU countries.** Colour scale is relative except when indicated, this means that it is applied independently to each column, and distinguishes best (green) from worst (red) situations according to each of the variables. **New!** Last column ( $EPG_{EST}$ ) indicates EPG assessed with **estimated real 14-day attack rate** (see report 39 for details).  $EPG_{REP}$  is calculated with **data reported by countries**.  $EPG_{REP}$  and  $EPG_{EST}$  **cannot be compared between them** because scales are different, but can be independently used for estimating risk of countries according to reported or estimated real situation, respectively.

Country	Reported data						Indexes		
	Cumulative cases	Attack rate /10 <sup>5</sup> inh.	Cumulative deaths	Mortality /10 <sup>5</sup> inh.	Active cases (last 14 days)	14-day attack rate /10 <sup>5</sup> inh.	$\rho_3^{(1)}$	$EPG_{REP}^{(2)}$	$EPG_{EST}^{(3)}$
Spain	219,764	474.2	22,524	48.6	62,742	135.4	0.97	131	1,452
Italy	192,994	324.7	25,969	43.7	45,417	76.4	0.85	65	911
Germany	152,438	186.1	5,500	6.7	34,780	42.5	0.75	32	141
United Kingdom	143,464	215.9	19,506	29.4	73,192	110.2	0.87	96	1,444
France	122,577	189.4	22,245	34.4	31,901	49.3	1.21	60	1,242
Belgium	44,293	390.0	6,679	58.8	17,626	155.2	0.79	122	2,411
Netherlands	36,535	215.1	4,289	25.2	13,438	79.1	0.70	55	723
Switzerland	28,595	333.7	1,308	15.3	4,367	51.0	0.54	28	139
Portugal	22,797	219.8	854	8.2	7,325	70.6	1.03	73	326
Ireland	18,184	384.8	829	17.5	10,095	213.6	0.84	180	943
Sweden	17,567	178.6	2,152	21.9	7,882	80.1	1.06	85	1,771
Austria	15,068	173.0	513	5.9	1,508	17.3	0.72	13	45
Poland	10,892	28.5	494	1.3	4,937	12.9	0.77	10	62
Romania	10,417	52.7	552	2.8	4,950	25.0	0.97	24	151
Denmark	8,210	143.7	403	7.1	2,391	41.9	0.98	41	223
Norway	7,408	138.0	191	3.6	1,164	21.7	0.81	18	50
Czech Republic	7,273	68.5	215	2.0	1,541	14.5	0.76	11	39
Finland	4,395	79.9	177	3.2	1,626	29.5	0.97	29	156
Luxembourg	3,695	641.5	85	14.8	472	81.9	0.66	54	ND
Greece	2,490	22.3	130	1.2	479	4.3	7.46	32	201
Hungary	2,443	25.0	262	2.7	1,133	11.6	1.17	14	219
Croatia	2,009	47.7	51	1.2	514	12.2	1.03	13	ND
Iceland	1,789	491.1	10	2.7	114	31.3	0.41	13	ND
Estonia	1,605	122.3	46	3.5	347	26.4	0.48	13	ND
Lithuania	1,410	48.5	40	1.4	411	14.1	0.31	4	ND
Slovenia	1,373	66.1	80	3.8	213	10.3	0.42	4	ND
Slovakia	1,360	25.0	17	0.3	645	11.8	0.65	8	ND
Bulgaria	1,188	16.7	54	0.8	553	7.8	1.32	10	ND
Cyprus	804	68.7	17	1.5	209	17.9	0.57	10	ND
Latvia	784	39.8	12	0.6	172	8.7	0.97	8	ND
Malta	447	104.2	3	0.7	97	22.6	ND	ND	ND
Liechtenstein	82	212.7	1	2.6	2	5.2	ND	ND	ND

Scale								
Worst	Worst	Worst	Worst	Worst	Worst	Worst	2.0	500
Best	Best	Best	Best	Best	Best	Best	0.0	0

<sup>(1)</sup> Disclaimer: parameter  $\rho$  is very sensitive and experiments daily variations.  $\rho_3$  is the average of 3 consecutive  $\rho$ , but can still fluctuate. <sup>(2)</sup> EPG stands for Effective Growth Potential.  $EPG_{REP}$  is obtained by multiplying attack rate of last 14 days per 10<sup>5</sup> inhabitants (i.e. density of cases) by  $\rho_3$  (a value related with effective reproduction number and that, therefore, determines the dynamics for subsequent days).  $EPG_{EST}$  is obtained by multiplying estimated real attack rate of last 14 days per 10<sup>5</sup> inhabitants by  $\rho_3$ .

## Time indicators by country

This table summarizes a few time indicators for each country: time since 50 cases were reported, time interval between an attack rate of  $1/10^5$  inhabitants and an attack rate of  $10/10^5$  inhabitants, and time interval between attack rates of 10 to 100 per  $10^5$  inhabitants (only for countries that have overtaken this threshold).

Countries	Days since the first 50 cases	Time interval between 1 and 10 cases / $10^5$ inh. (days)	Time interval between 10 and 100 cases / $10^5$ inh. (days)
Italy	63	11	16
France	57	10	20
Germany	57	12	17
Spain	56	7	12
United Kingdom	53	11	19
Norway	52	9	24
Switzerland	52	9	12
Netherlands	51	11	20
Sweden	51	10	28
Austria	50	10	14
Belgium	50	11	14
Greece	49	18	ND
Iceland	49	5	15
Denmark	47	4	30
Czech Republic	46	11	ND
Finland	45	12	ND
Portugal	45	9	15
Slovenia	45	6	ND
Ireland	44	8	18
Romania	44	15	ND
Estonia	43	5	30
Poland	43	12	ND
Bulgaria	41	15	ND
Luxembourg	41	6	7
Slovakia	41	17	ND
Croatia	40	12	ND
Latvia	39	12	ND
Cyprus	38	12	ND
Hungary	38	12	ND
Malta	37	8	34
Lithuania	36	9	ND
Liechtenstein	31	9	11

## Situation, trends and long-term predictions in Italian and Spanish regions

### Italy

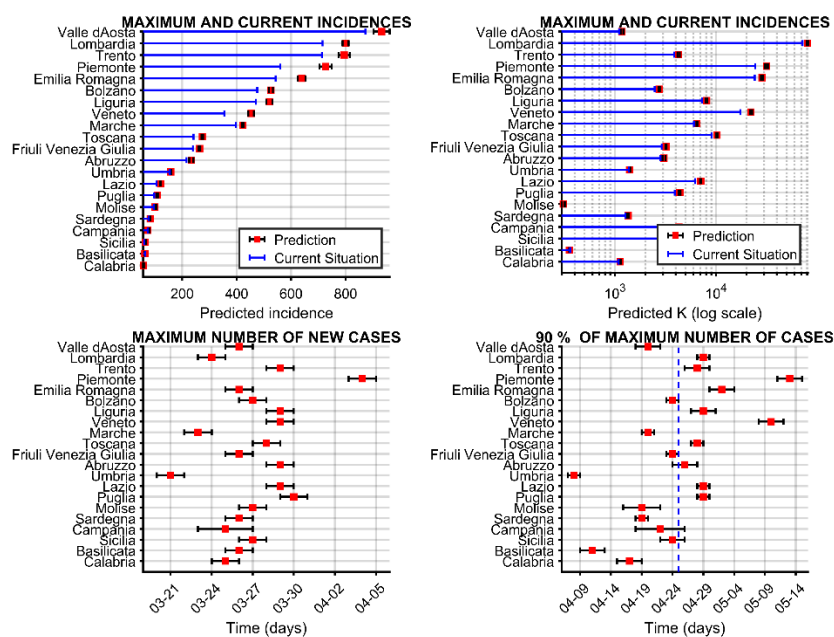
Country	Reported data						Indexes		
	Cumulative cases	Attack rate / 10 <sup>5</sup> inh.	Cumulative deaths	Mortality / 10 <sup>5</sup> inh.	Active cases (last 14 days)	14-day attack rate / 10 <sup>5</sup> inh	$\rho_3^{(1)}$	EPG <sub>REP</sub> <sup>(2)</sup>	EPG <sub>EST</sub> <sup>(3)</sup>
Lombardia	71,969	716.7	13,269	132.1	14,377	143.2	1.02	146	2,890
Piemonte	24,426	560.7	2,767	63.5	8,418	193.2	0.95	184	2,395
Emilia Romagna	24,209	542.9	3,347	75.1	4,574	102.6	0.77	79	1,148
Veneto	17,391	354.5	1,288	26.3	3,623	73.9	0.82	60	511
Toscana	9,015	241.7	760	20.4	2,057	55.2	0.64	35	328
Liguria	7,301	470.8	1,093	70.5	1,925	124.1	0.89	111	1,806
Lazio	6,224	105.9	387	6.6	1,501	25.5	0.68	17	114
Marche	6,058	397.2	874	57.3	847	55.5	0.74	41	637
Campania	4,299	74.1	341	5.9	782	13.5	0.96	13	106
Puglia	3,912	97.1	391	9.7	1,008	25.0	0.97	24	280
Trento	3,838	357.9	400	37.3	868	80.9	0.74	60	1,359
Sicilia	3,020	60.4	224	4.5	656	13.1	1.10	14	120
Friuli Venezia Giulia	2,903	238.9	263	21.6	510	42.0	0.67	28	266
Abruzzo	2,832	215.9	293	22.3	712	54.3	0.73	39	445
Bolzano	2,476	2,304.6	265	246.7	519	483.1	0.48	230	491
Umbria	1,366	154.9	63	7.1	57	6.5	0.62	4	ND
Sardegna	1,271	77.5	103	6.3	180	11.0	0.53	6	52
Valle d'Aosta	1,100	875.8	130	103.5	198	157.6	0.06	10	116
Calabria	1,088	55.9	80	4.1	173	8.9	0.87	8	ND
Basilicata	361	64.1	25	4.4	49	8.7	1.27	11	ND
Molise	292	95.5	21	6.9	46	15.1	0.49	7	ND

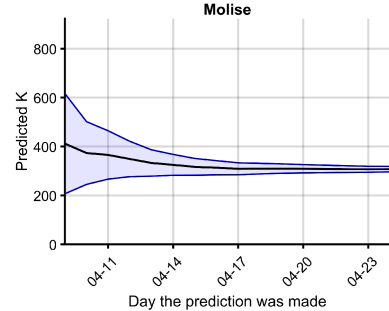
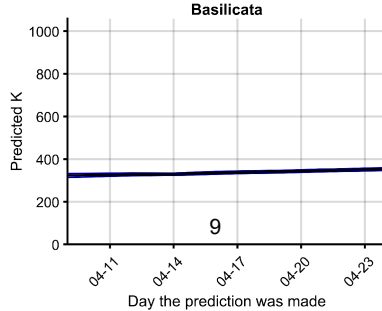
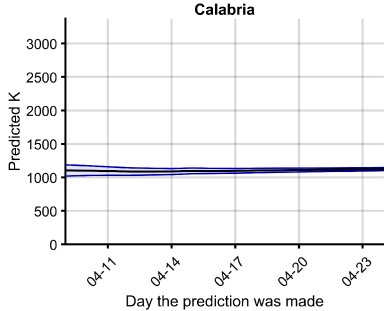
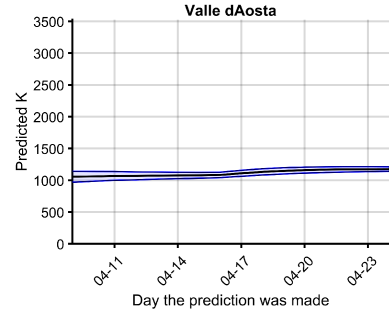
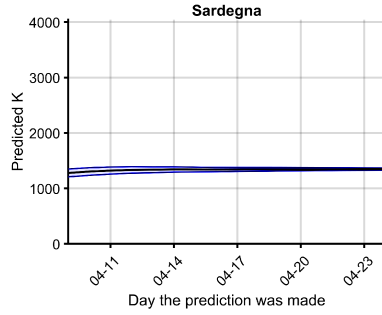
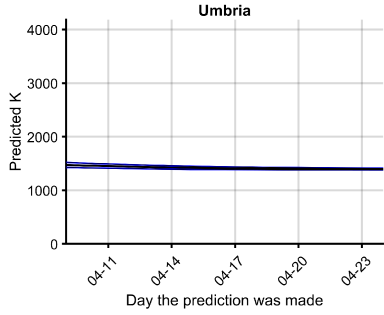
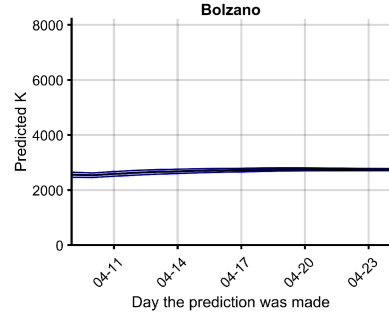
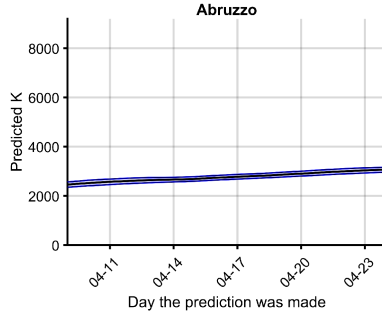
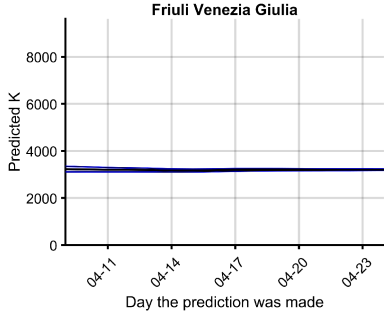
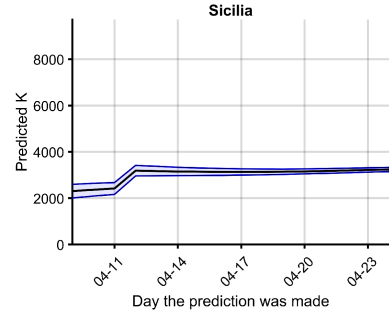
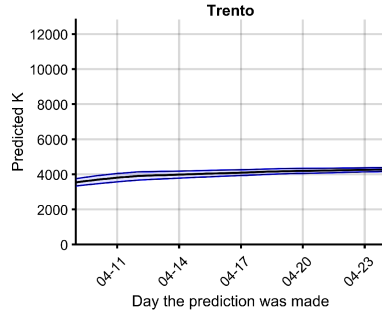
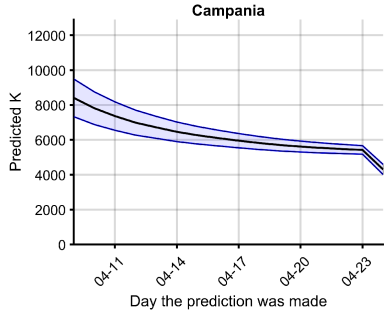
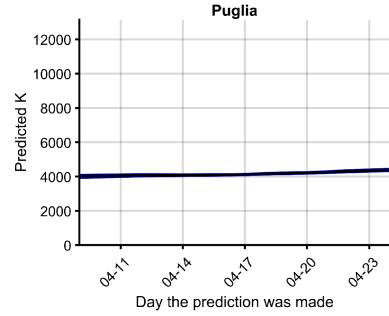
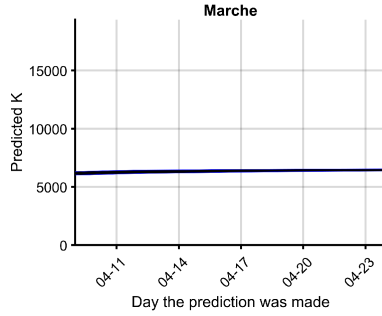
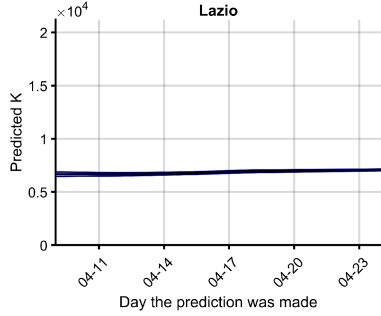
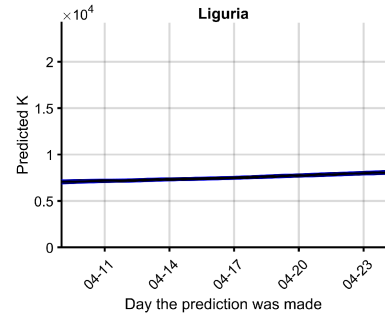
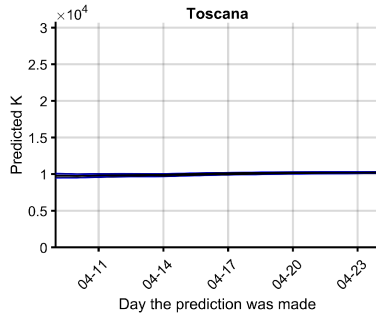
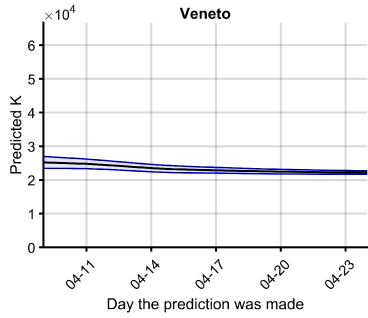
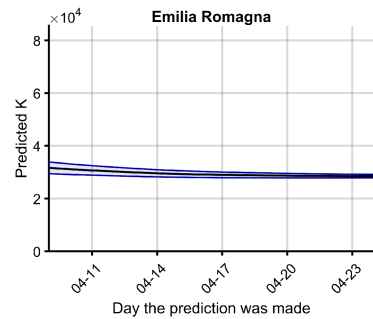
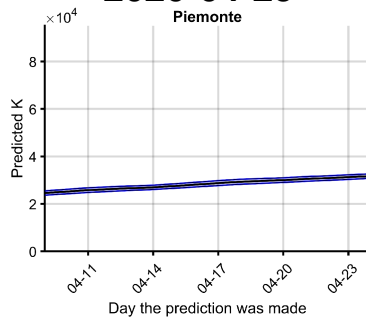
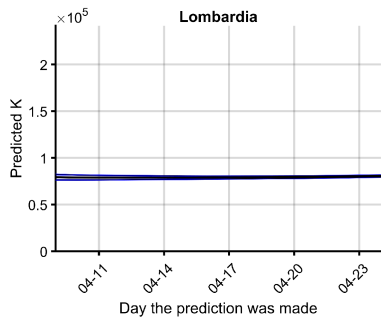
Scale							2.0	500	2500
Worst	Worst	Worst	Worst	Worst	Worst	Worst			
Best	Best	Best	Best	Best	Best	Best	0.0	0	0

<sup>(1)</sup> Disclaimer: parameter  $\rho$  is very sensitive and experiments daily variations.  $\rho_3$  is the average of 3 consecutive  $\rho$ , but can still fluctuate. <sup>(2)</sup> EPG stands for Effective Growth Potential. EPG<sub>REP</sub> is obtained by multiplying attack rate of last 14 days per 10<sup>5</sup> inhabitants (i.e. density of cases) by  $\rho_3$  (a value related with effective reproduction number and that, therefore, determines the dynamics for subsequent days). EPG<sub>EST</sub> is obtained by multiplying estimated real attack rate of last 14 days per 10<sup>5</sup> inhabitants by  $\rho_3$ .

**Long-term predictions.** These plots show long-term predictions of: new cases' peaks, final incidence value and approximate date when 90% of total final incidence will be reached. In all three cases we are dealing with the evaluation of global dynamics, which requires small changes in methodology: all data points be used instead of last 15 and with equal weight distribution among them. Blue dashed line indicates current timepoint. See details in Report from 11th April 2020.

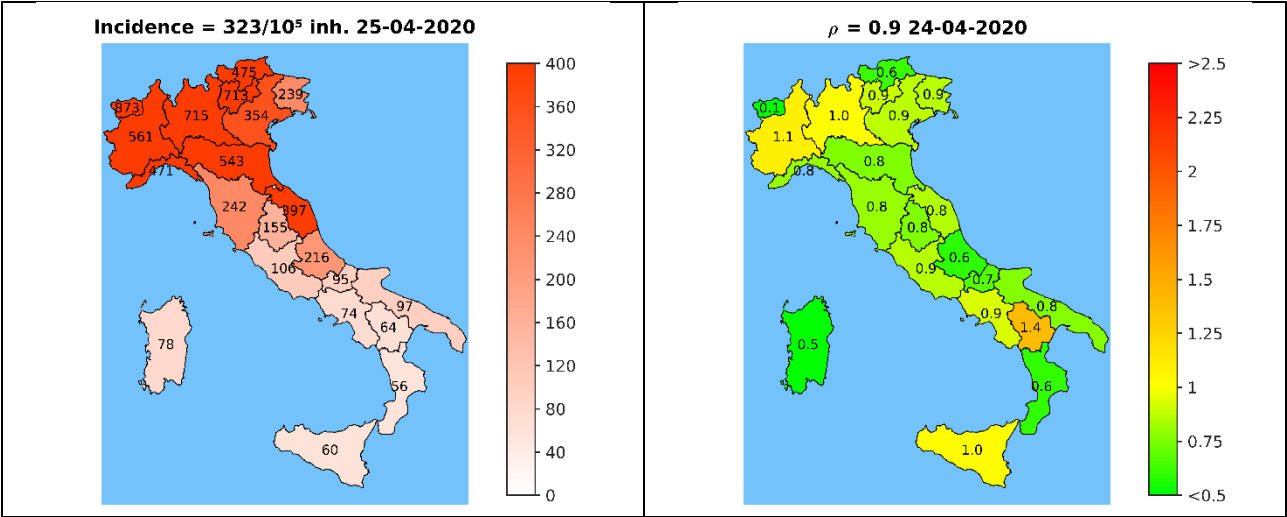


2020-04-25





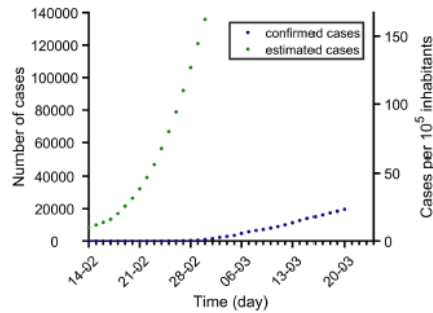
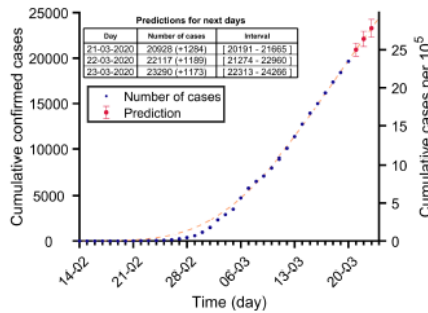
**Maps.** Cumulated incidence and spreading rate ( $\rho$ ) in Italian regions.



## Legend: Countries' reports details

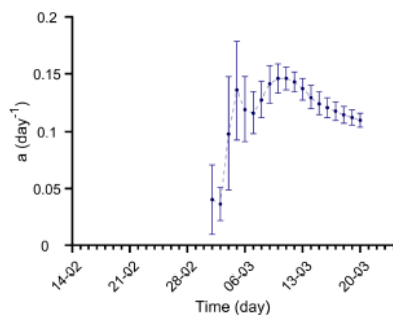
Iran 20-03-2020. Population: 83.7M. Current cumulated incidence:  $23/10^5$

Confirmed cases:  
data (blue),  
model fitted  
(dashed line),  
predictions (red  
points and table)

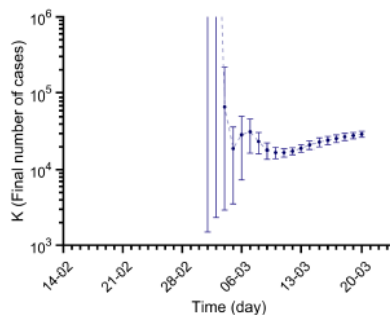


Estimated  
cases using  
death rate (see  
Methods)

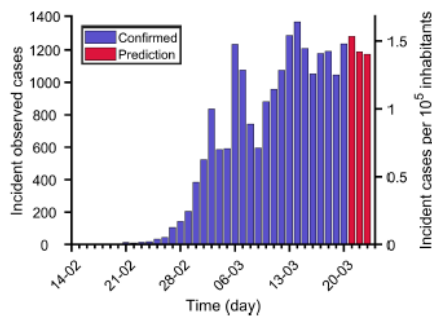
Fitted  $a$  value  
using points  
prior to each  
date



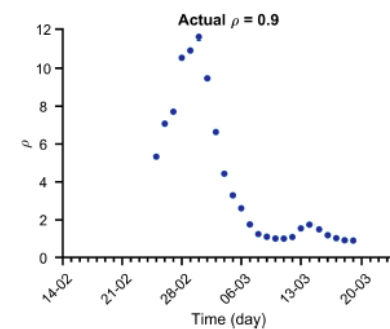
Fitted  $K$  value  
using points  
prior to each  
date



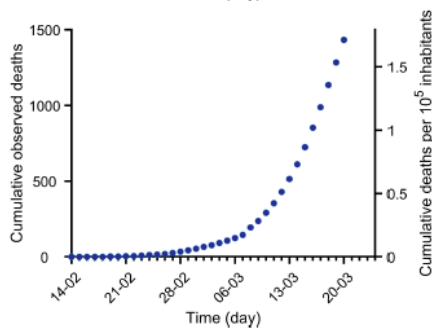
Reported  
and  
predicted  
new cases



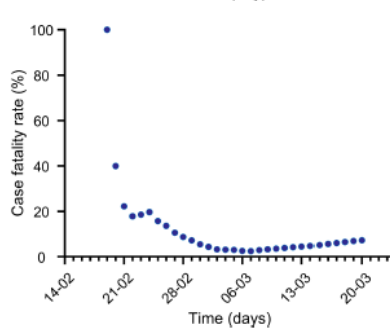
Evolution of  $\rho$ , a  
parameter related  
with Reproduction  
number (see  
Methods)



Reported  
deaths

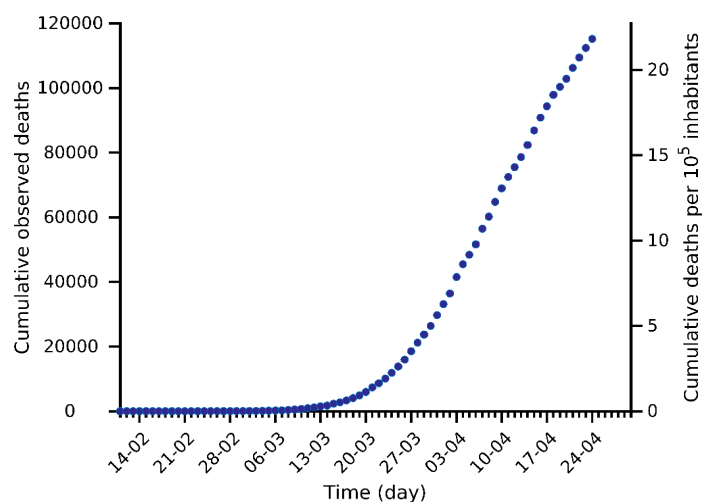
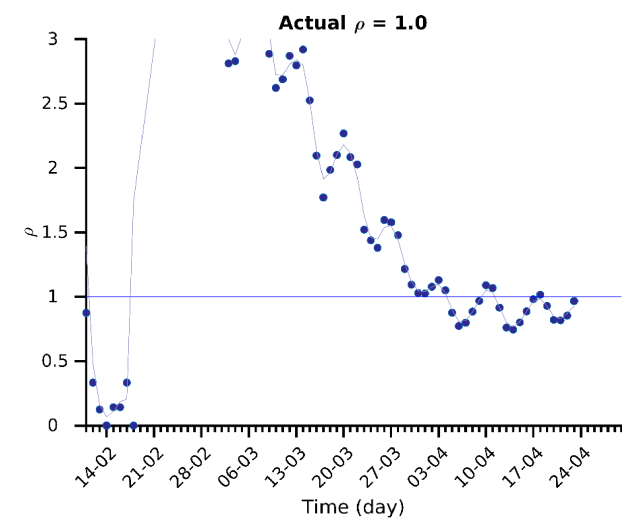
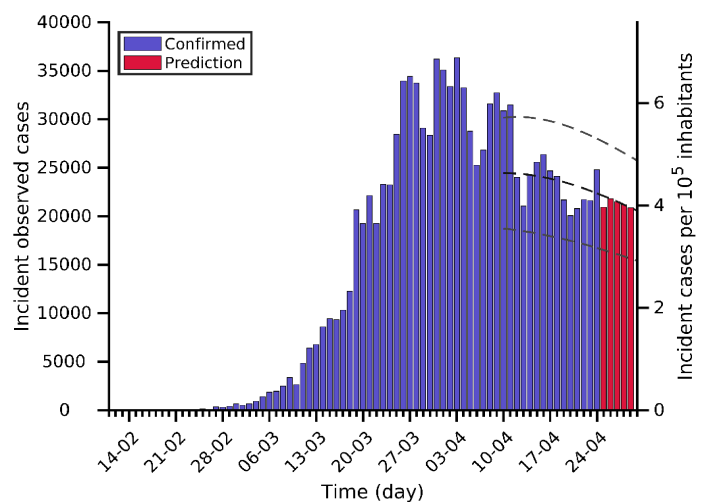
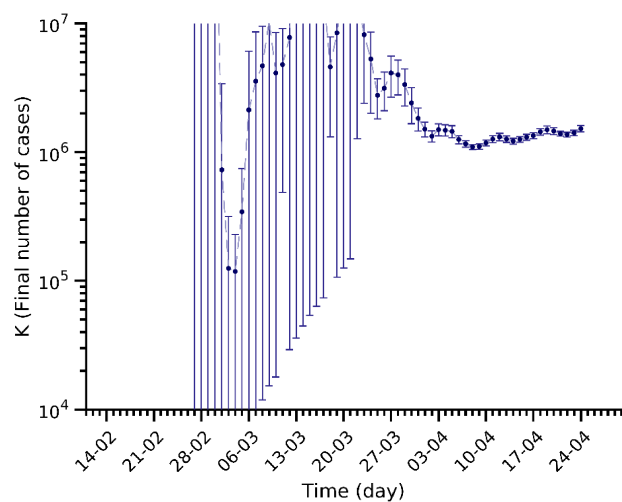
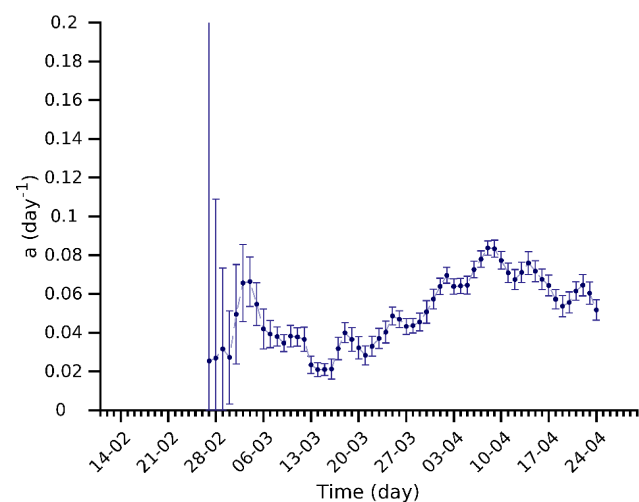
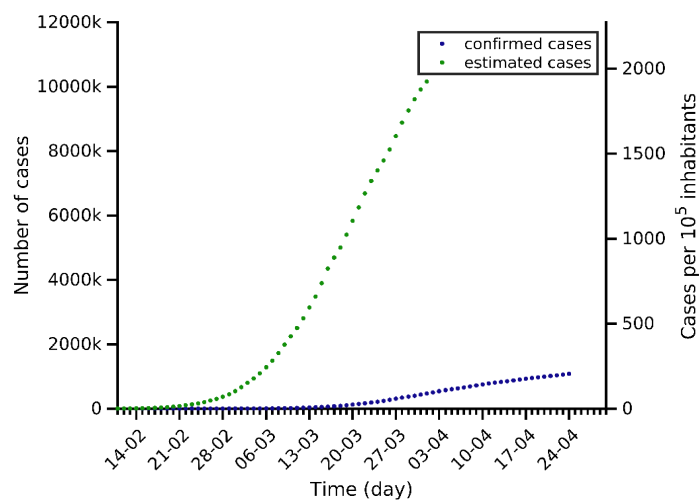
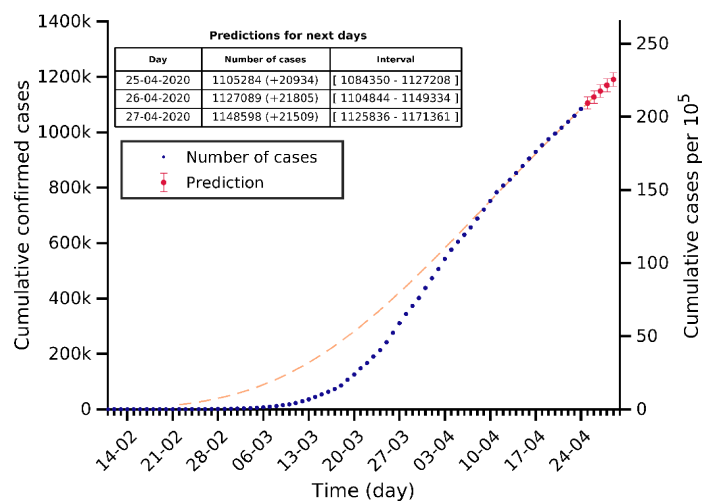


Deaths /  
cumulated  
reported cases

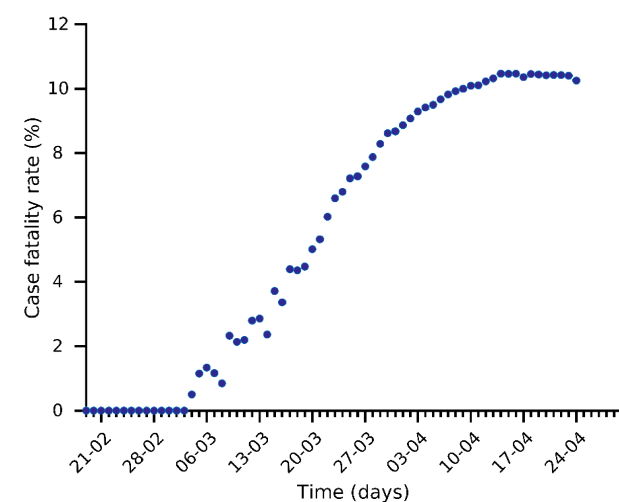
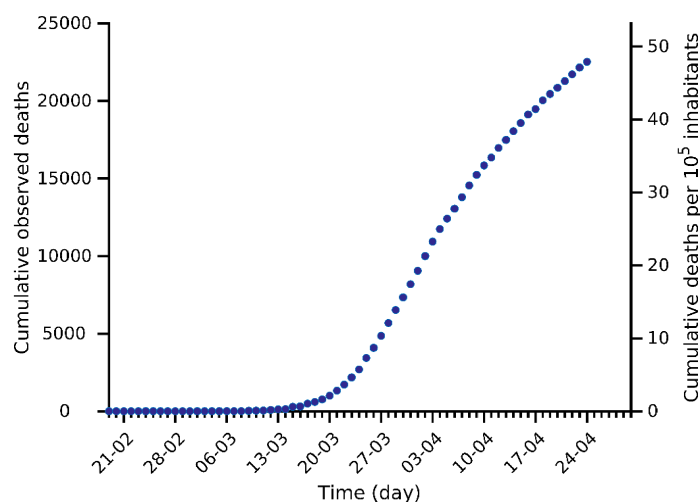
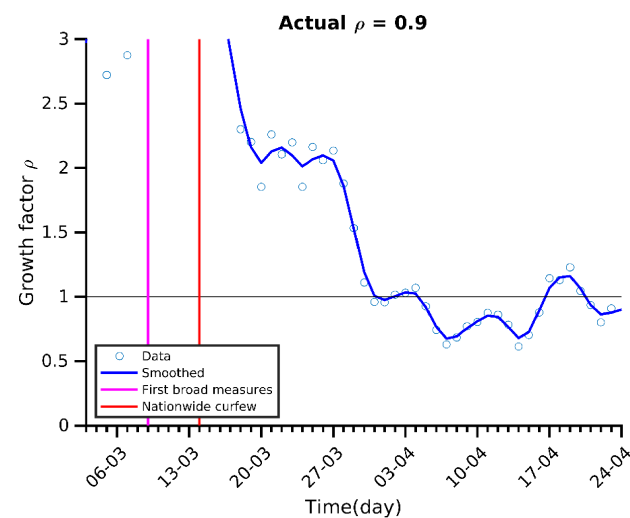
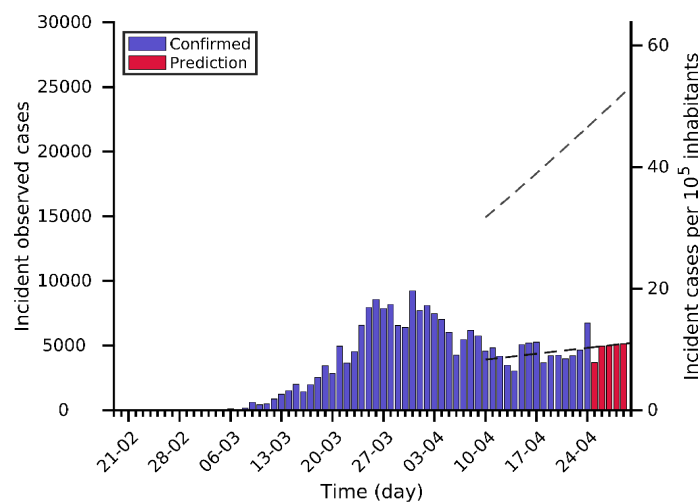
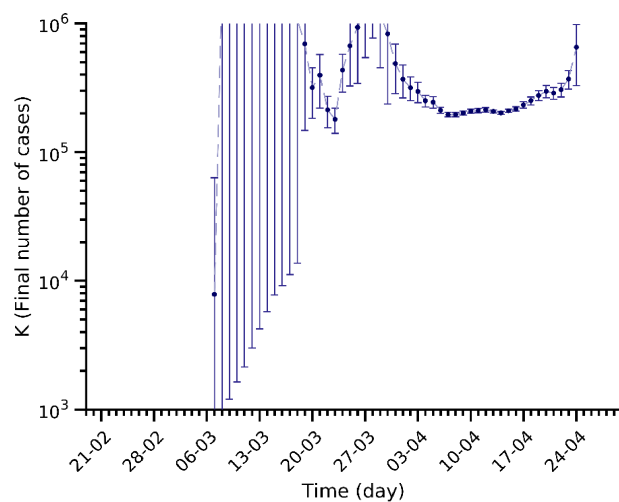
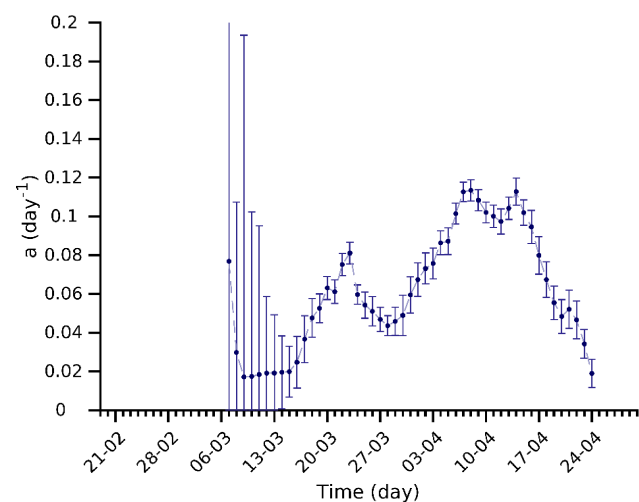
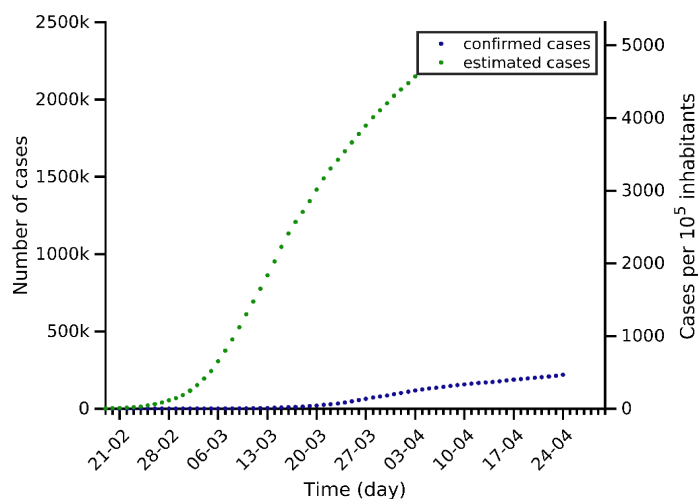
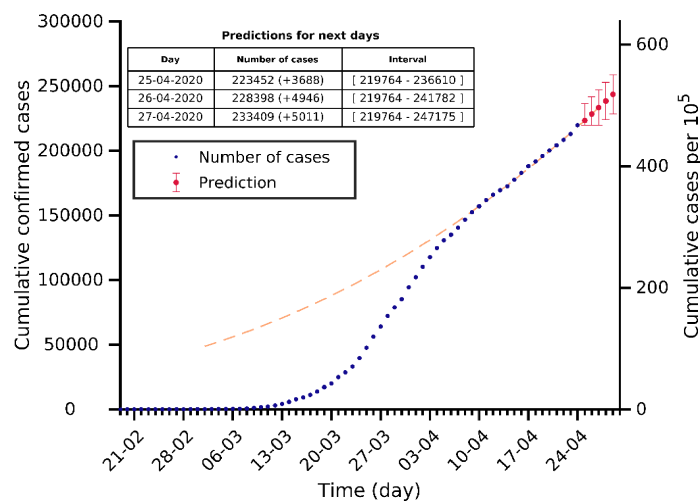


## **(1) Analysis and prediction of COVID-19 for EU+EFTA+UK**

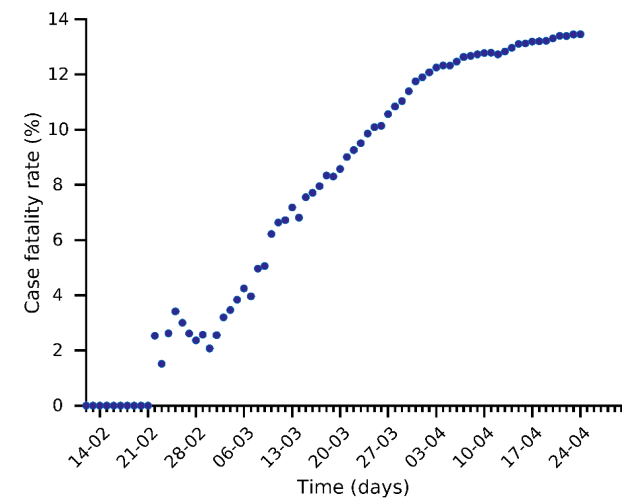
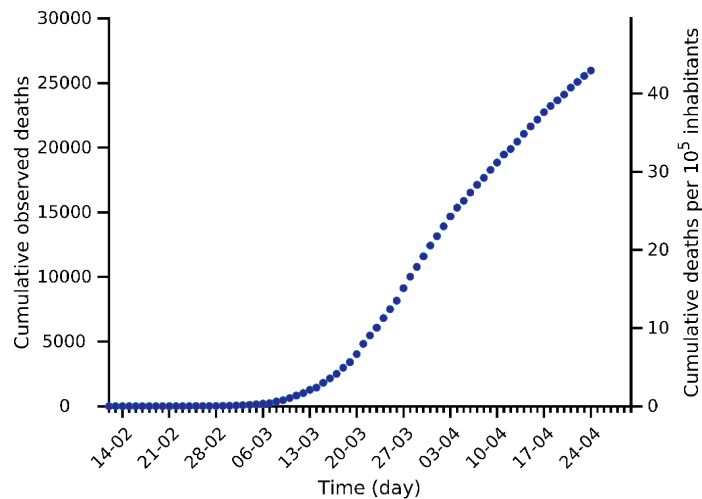
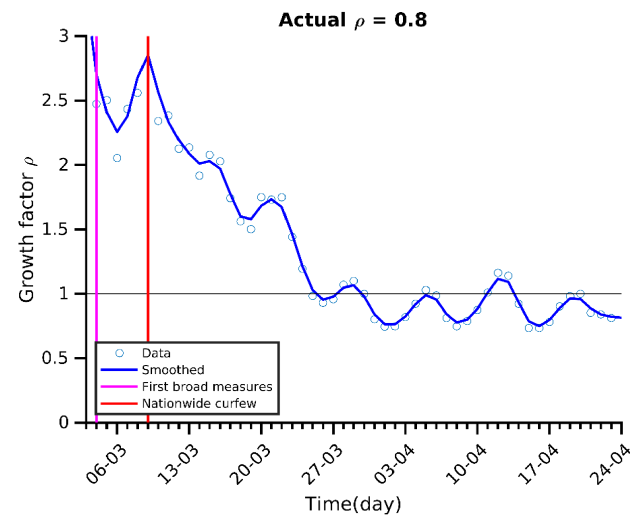
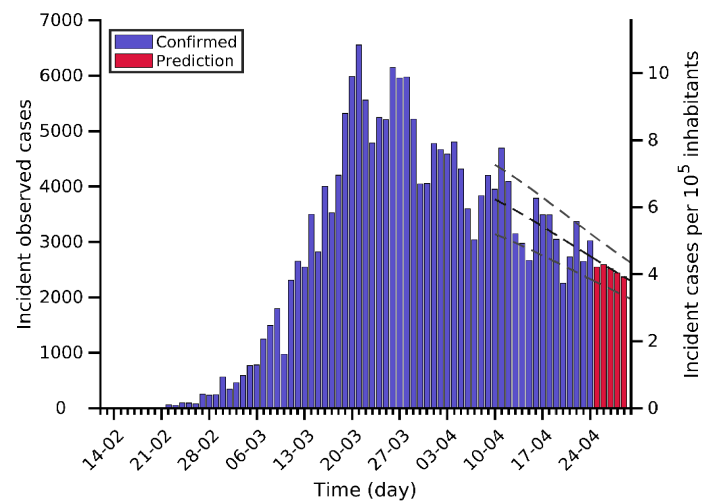
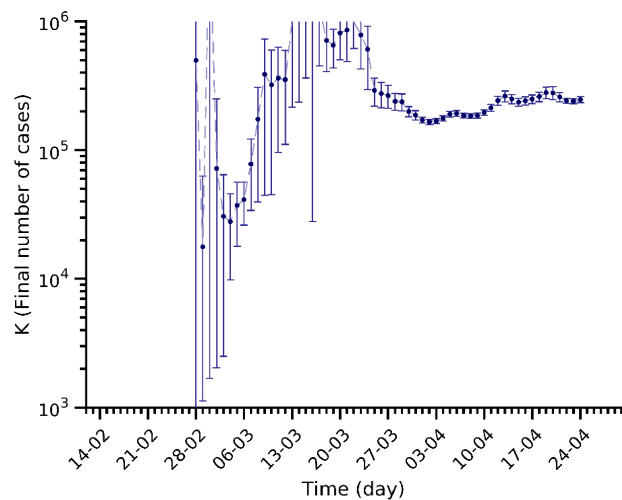
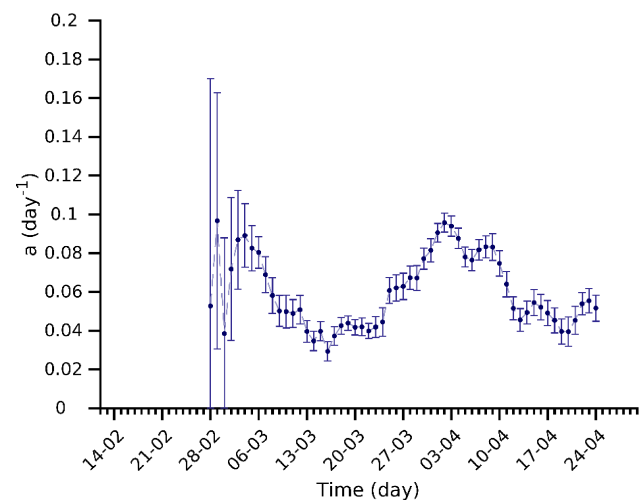
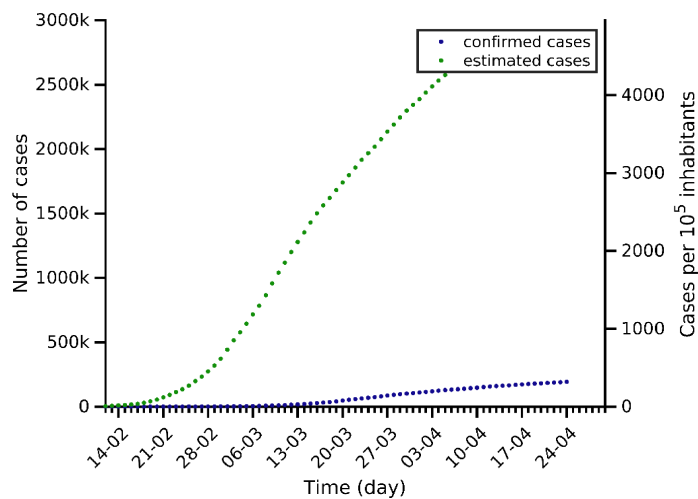
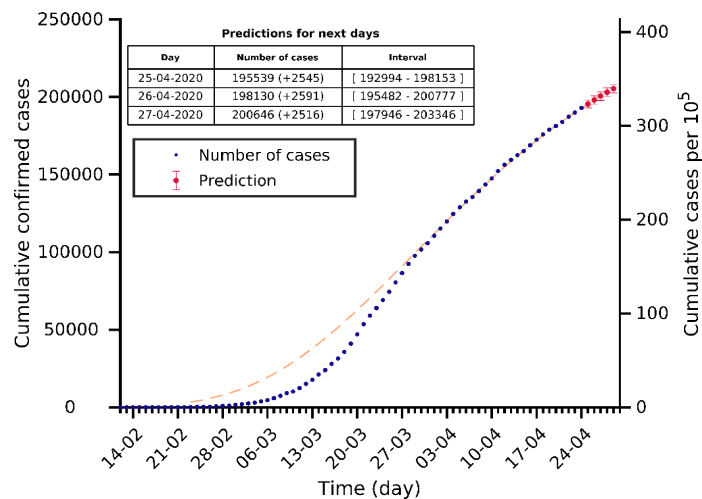
Data obtained from <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>  
<https://github.com/pcm-dpc/COVID-19/tree/master/dati-andamento-nazionale> (Italy)



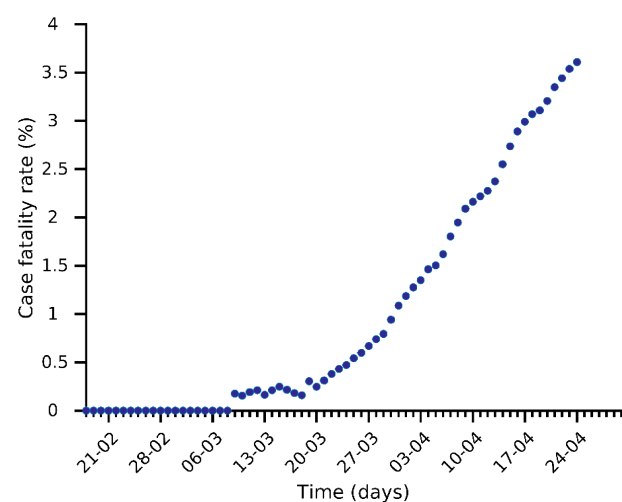
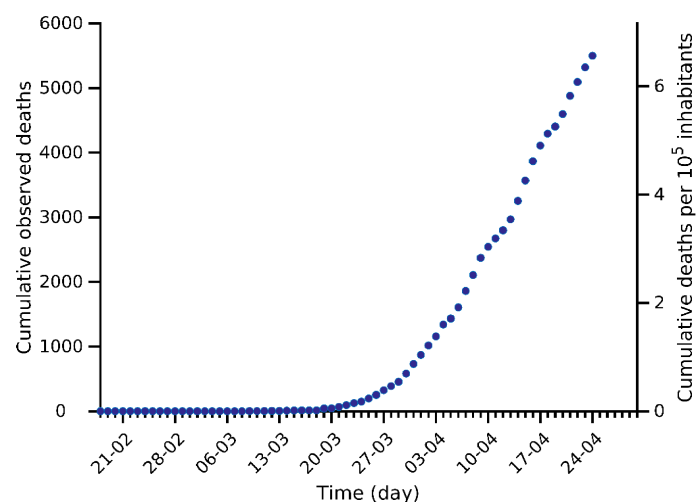
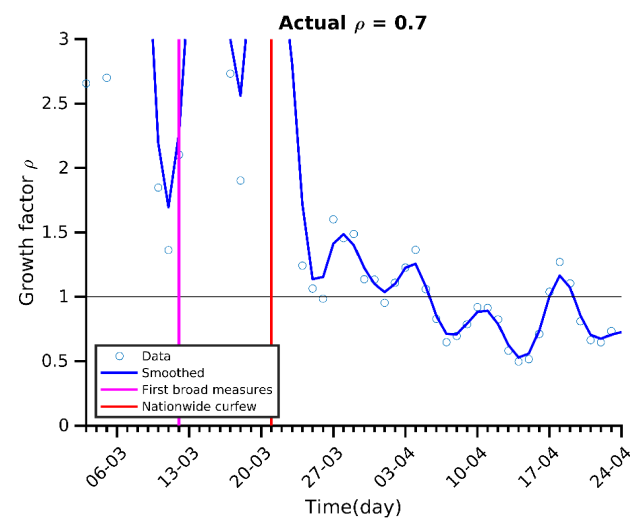
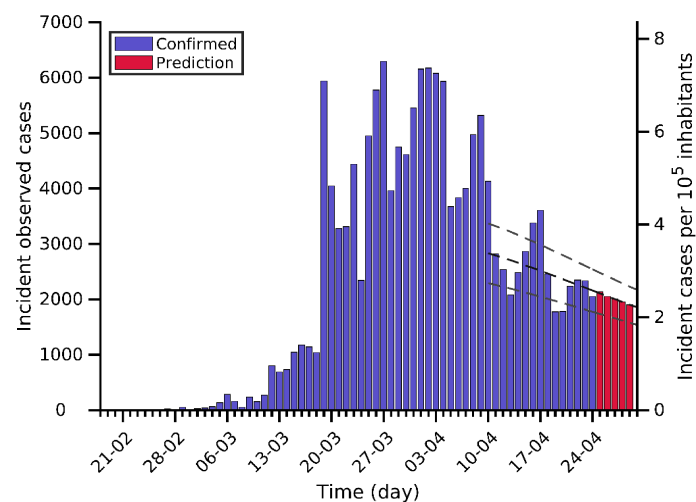
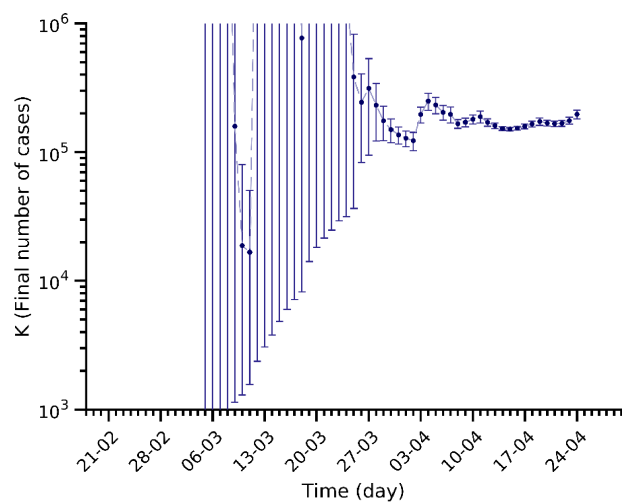
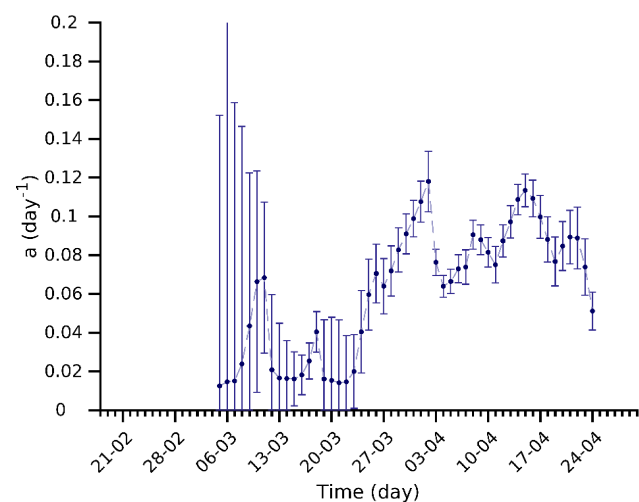
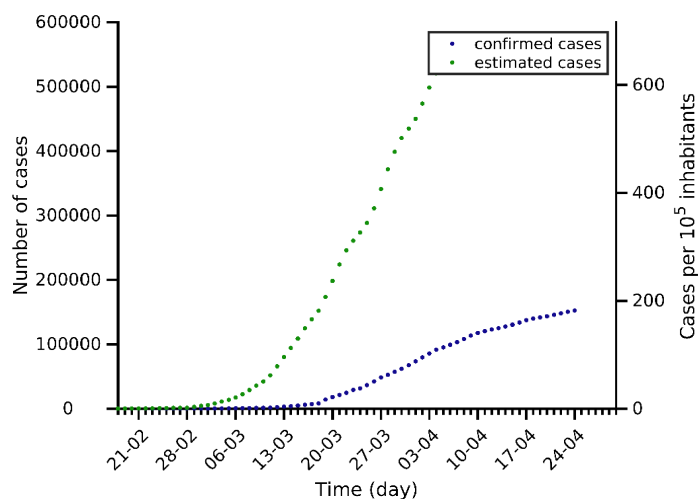
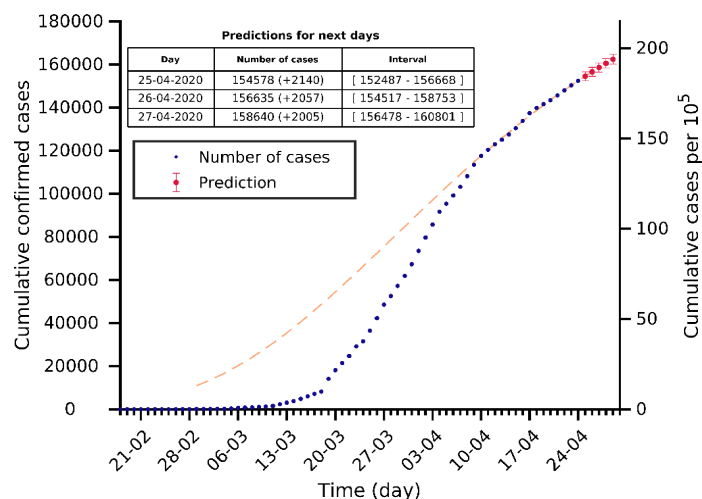
# Spain 24-04-2020. Population: 47.0M. Current cumulated incidence: 467/10<sup>5</sup>



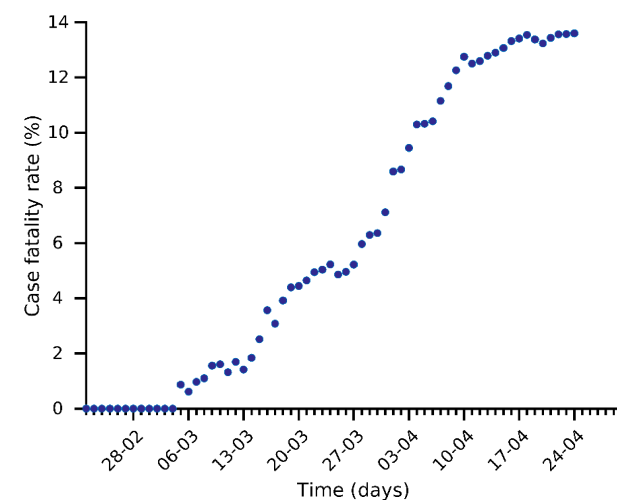
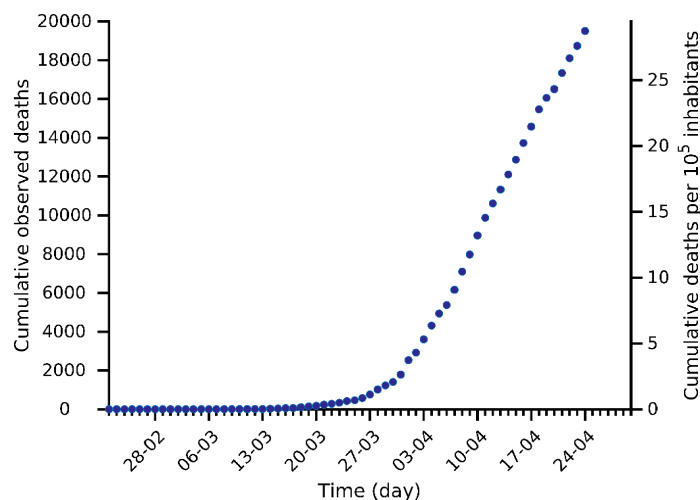
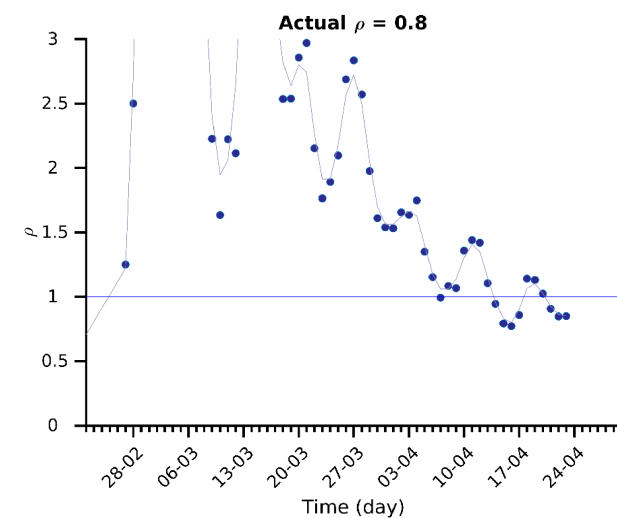
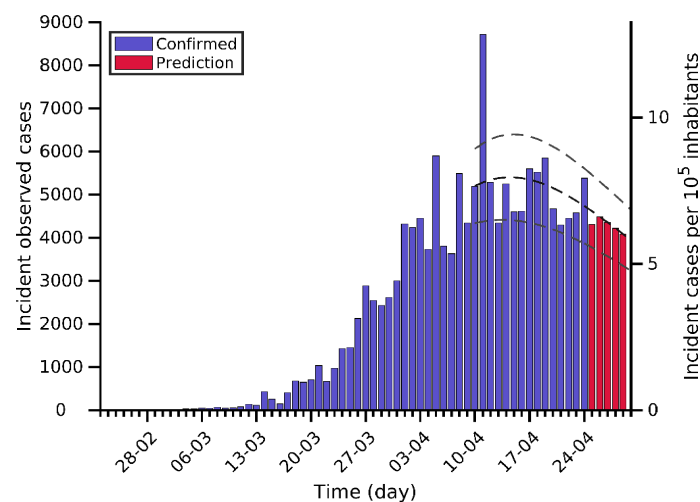
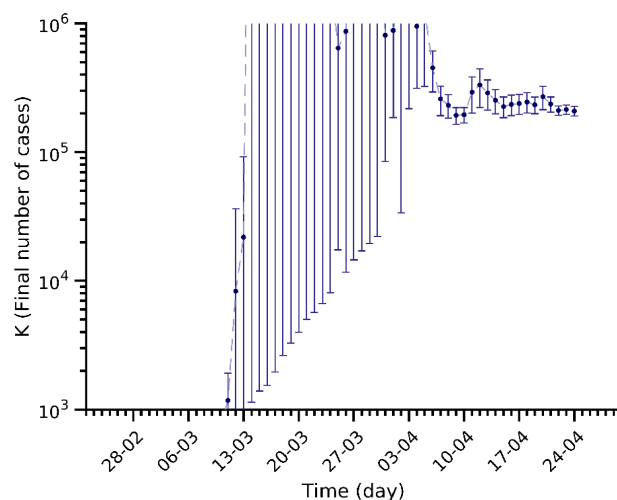
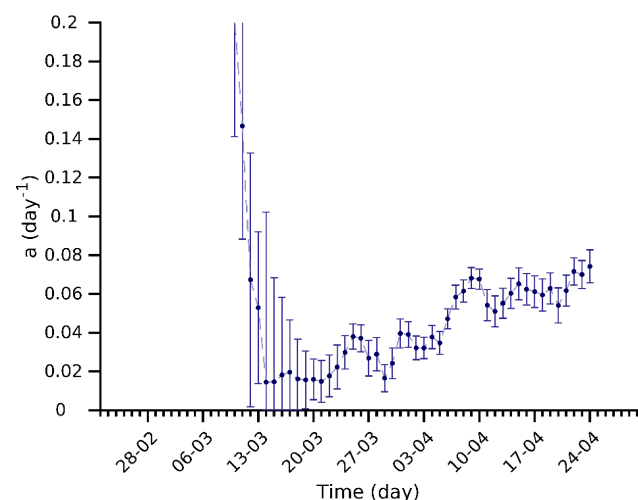
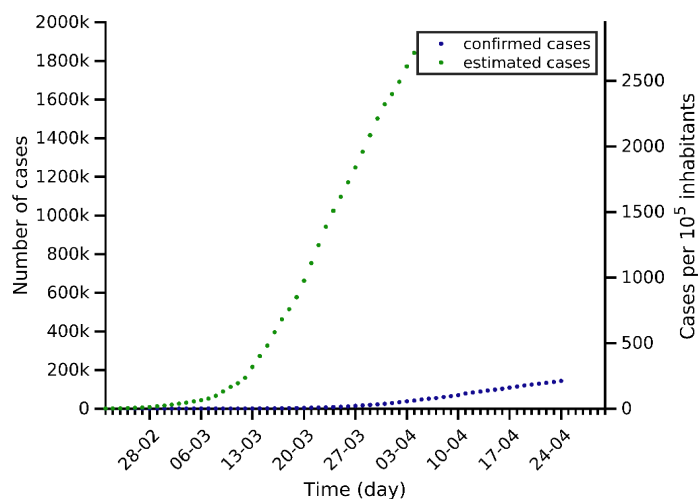
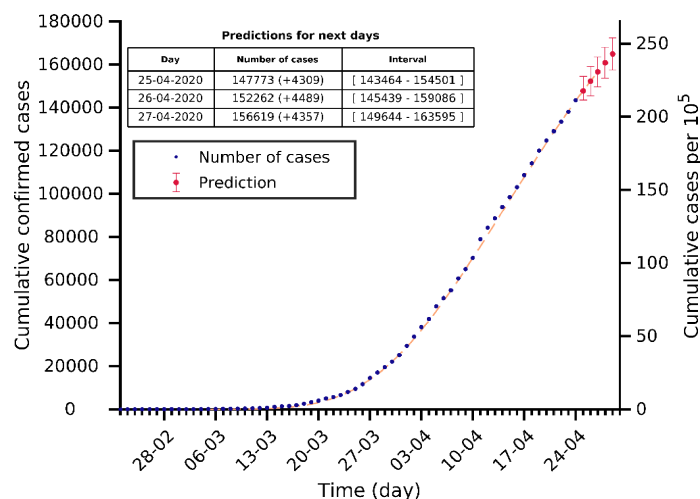
# Italy 24-04-2020. Population: 60.5M. Current cumulated incidence: 319/10<sup>5</sup>



# Germany 24-04-2020. Population: 83.8M. Current cumulated incidence: 182/10<sup>5</sup>

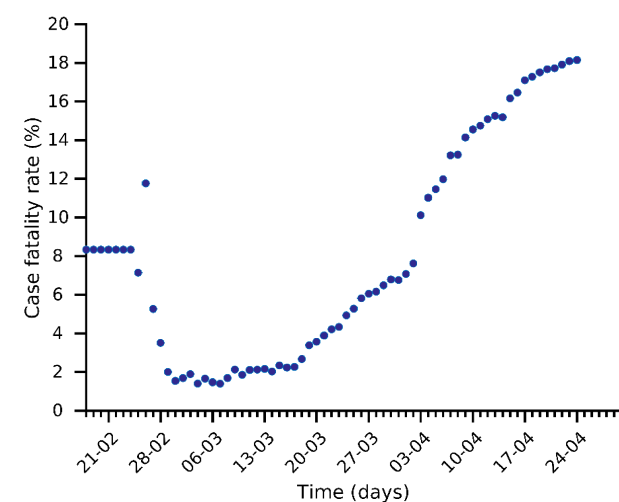
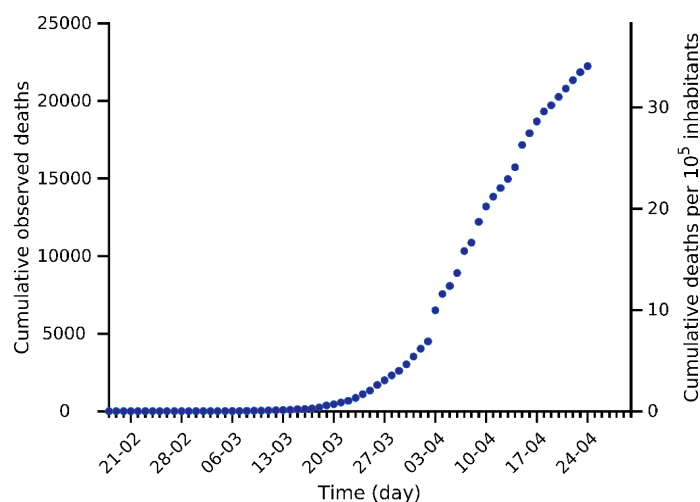
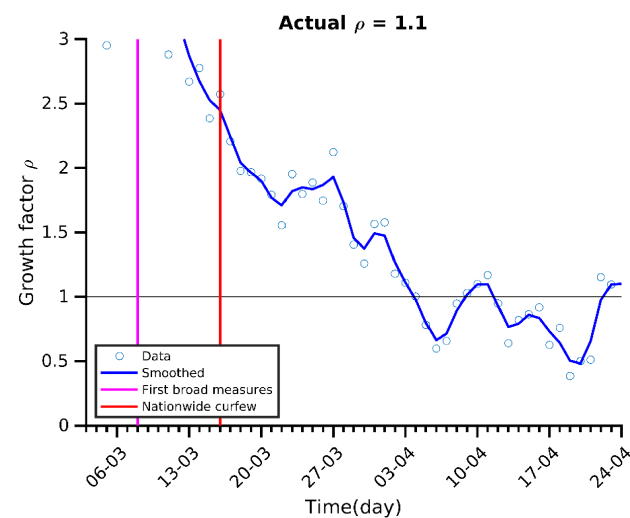
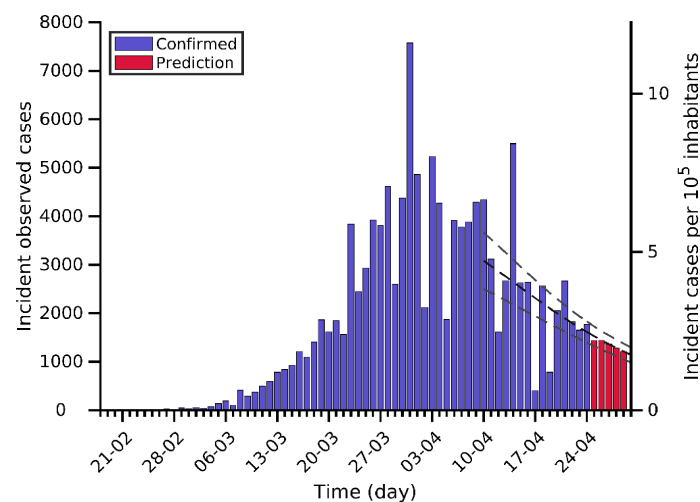
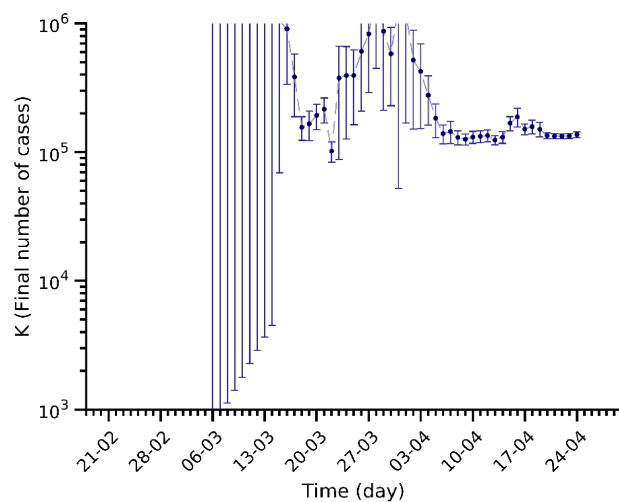
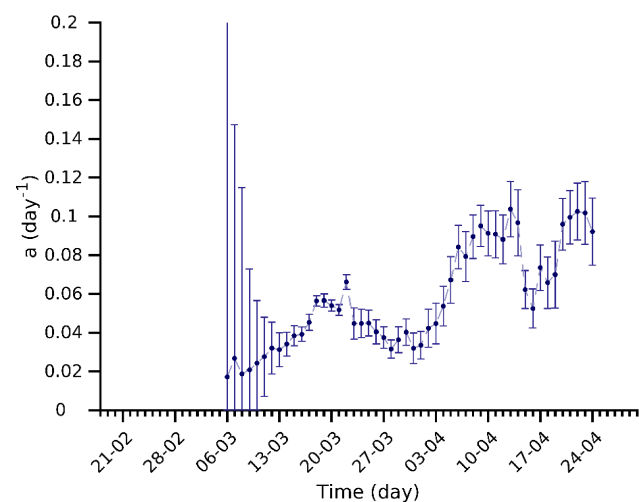
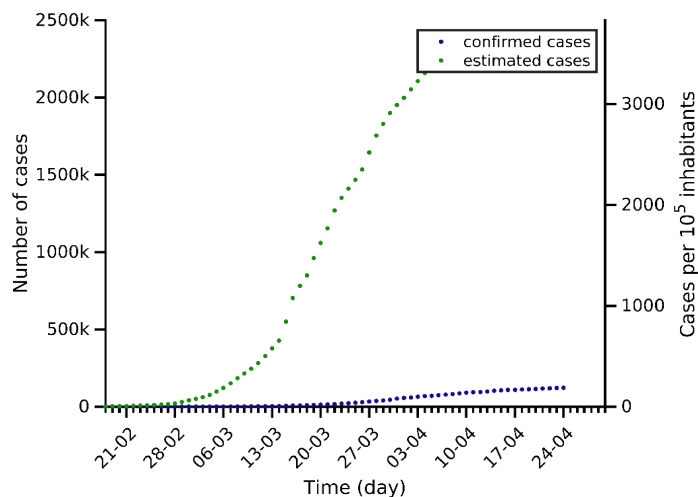
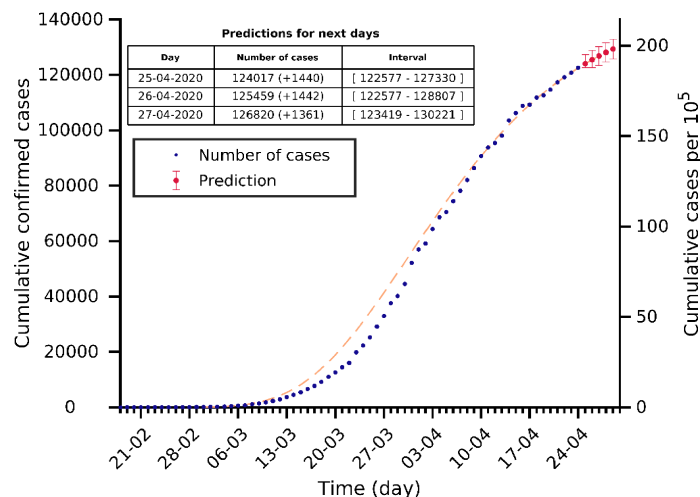


# UK 24-04-2020. Population: 67.9M. Current cumulated incidence: 211/10<sup>5</sup>

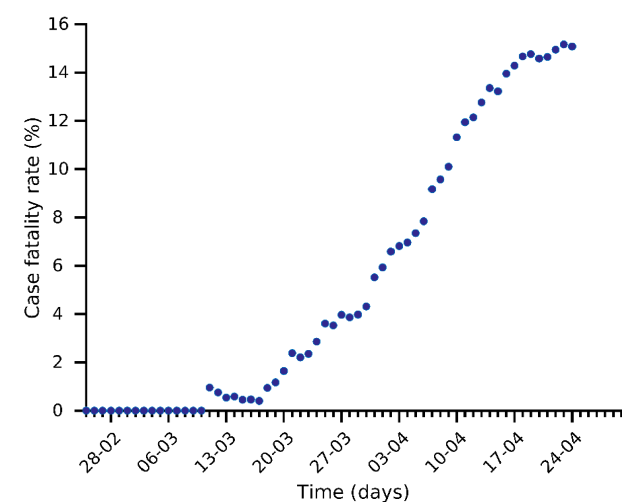
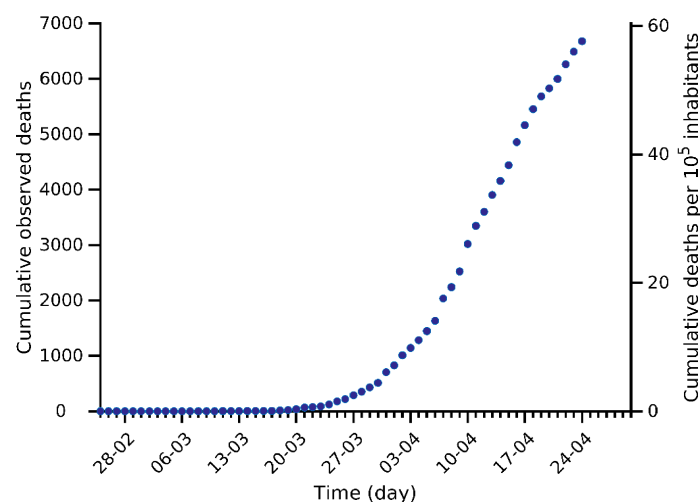
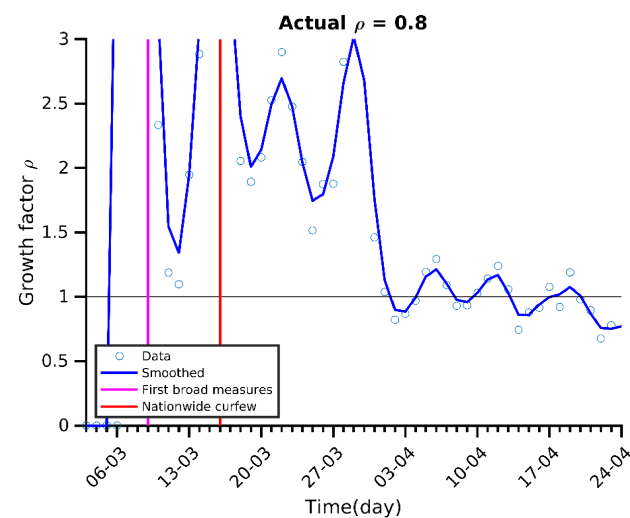
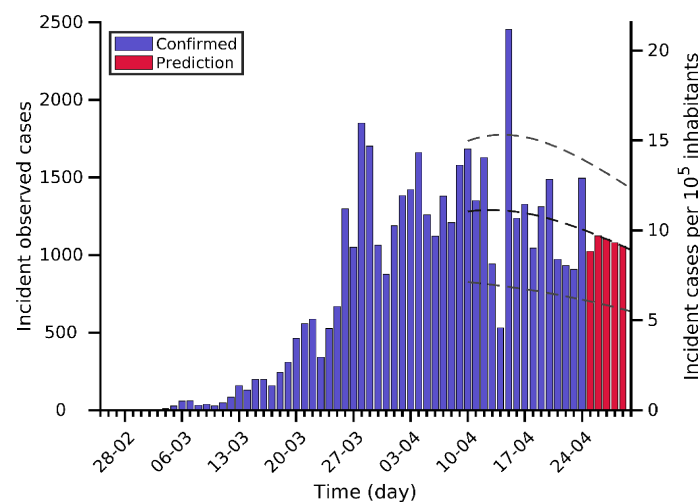
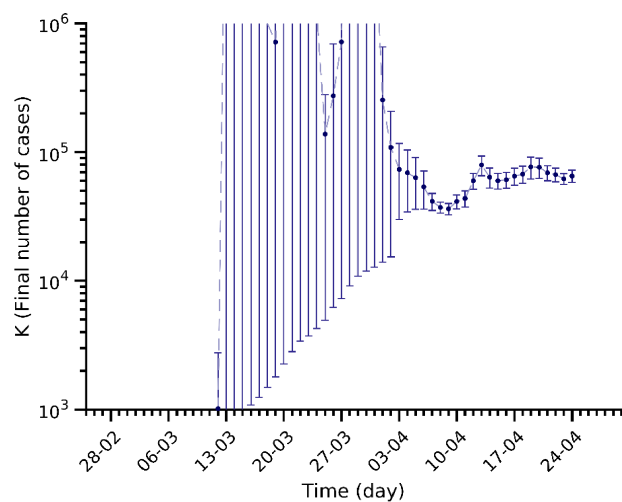
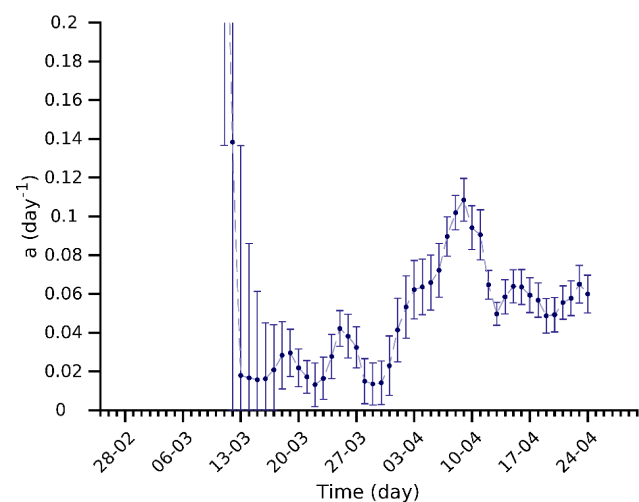
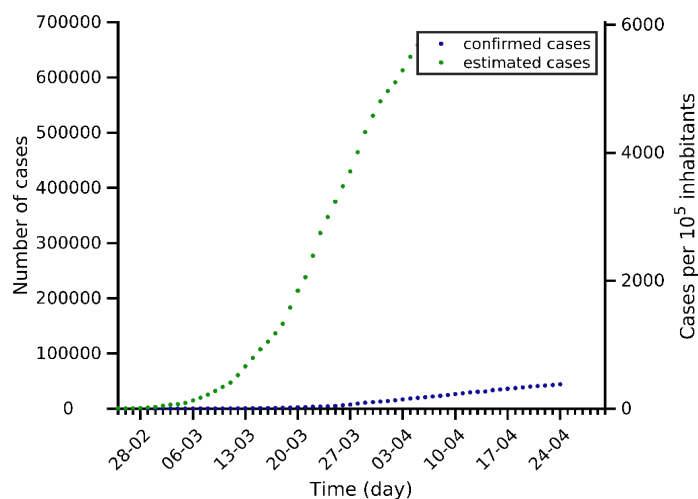
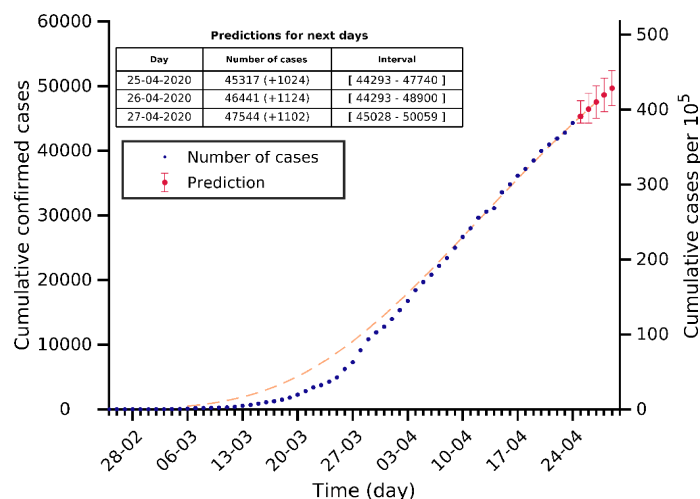




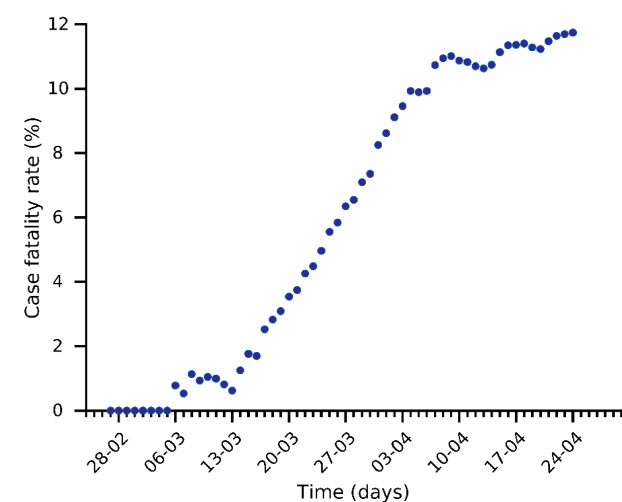
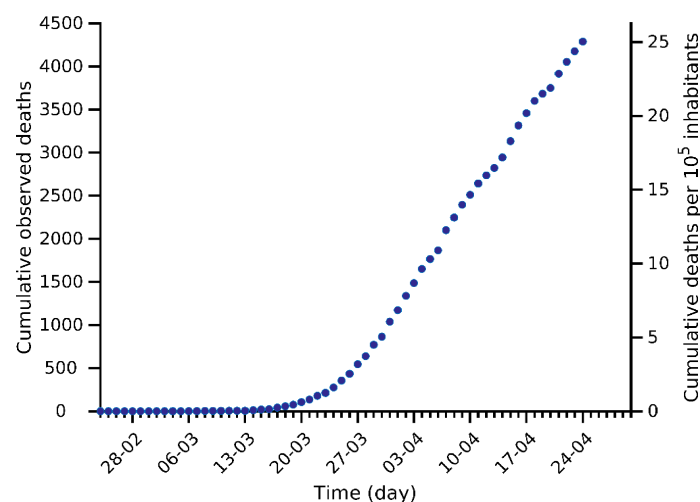
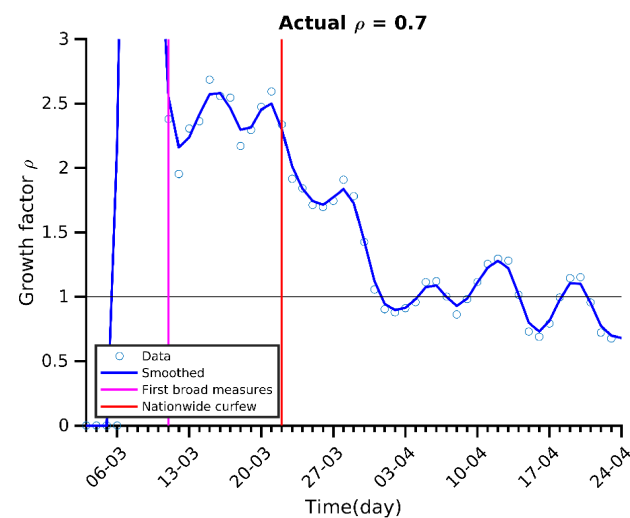
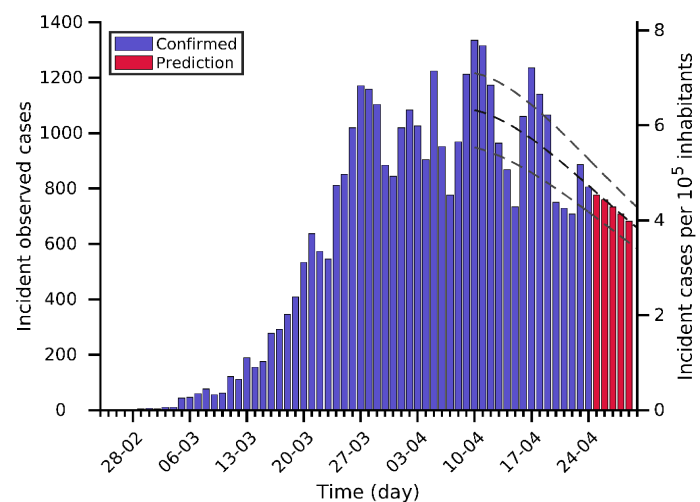
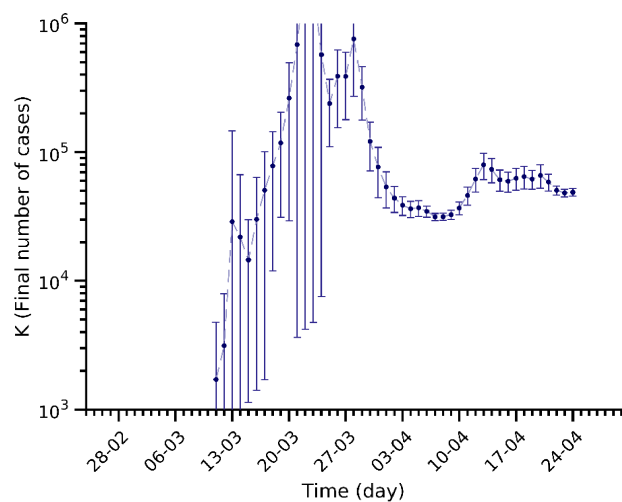
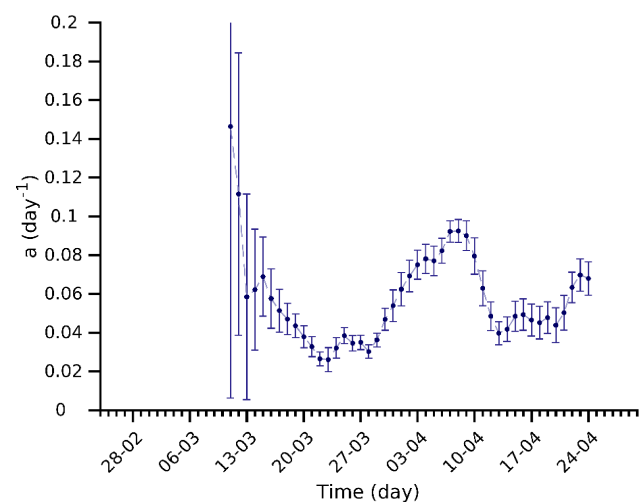
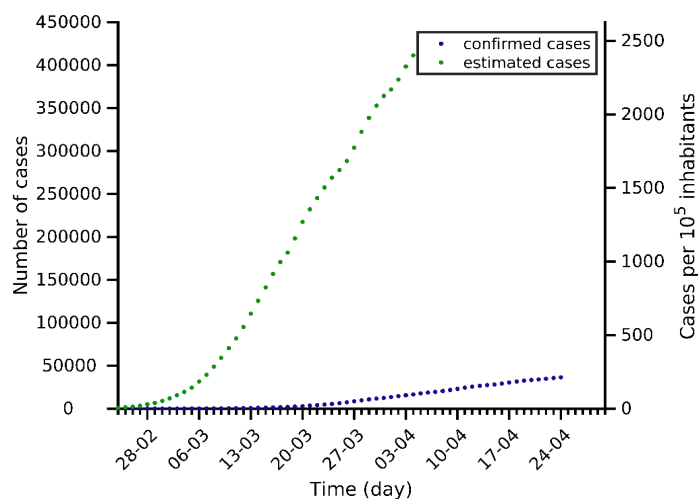
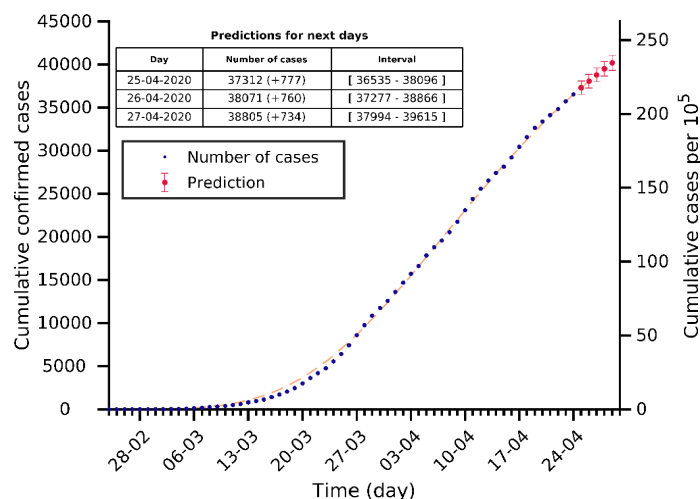
# France 24-04-2020. Population: 65.3M. Current cumulated incidence: 188/10<sup>5</sup>



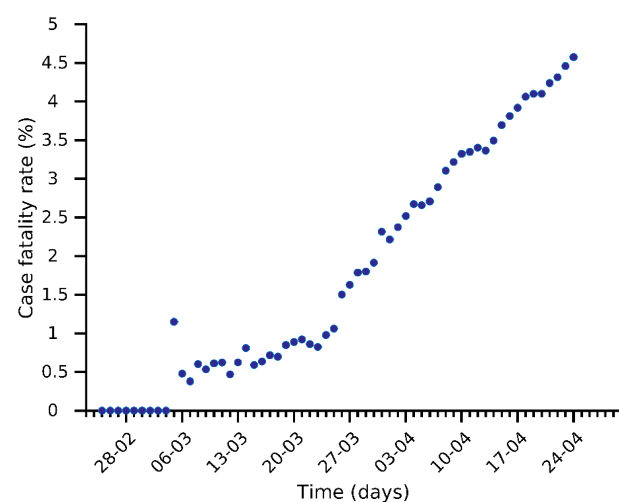
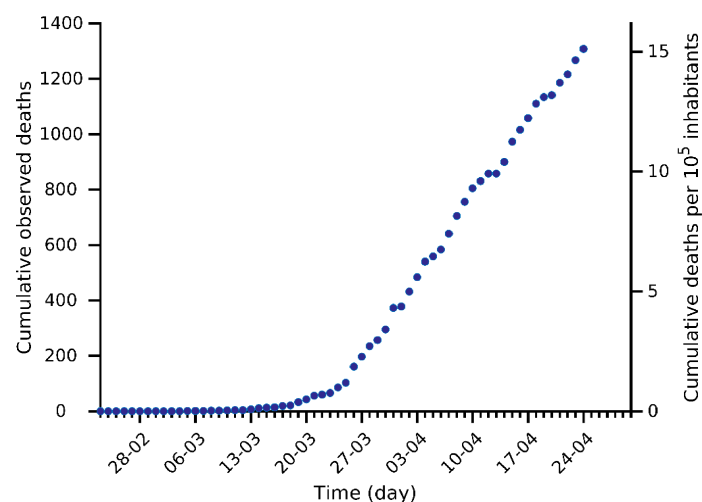
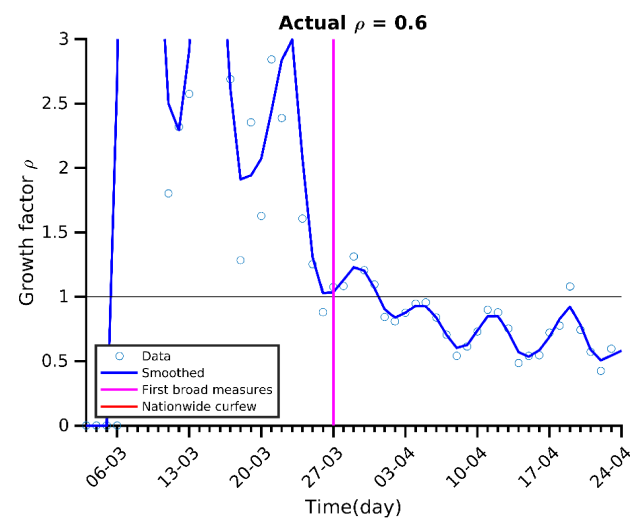
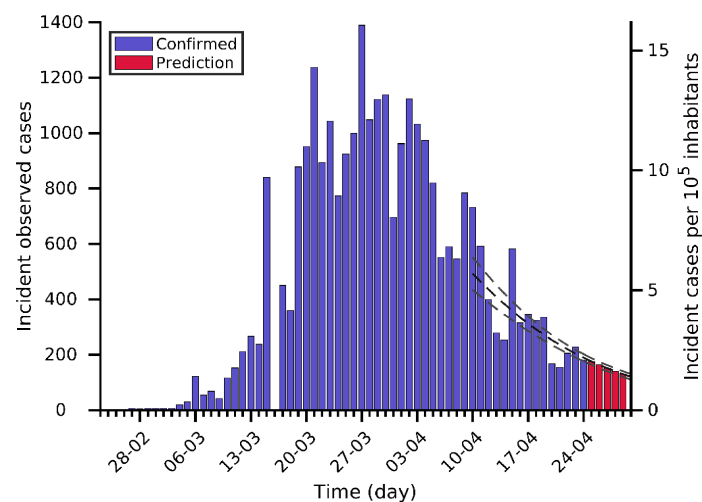
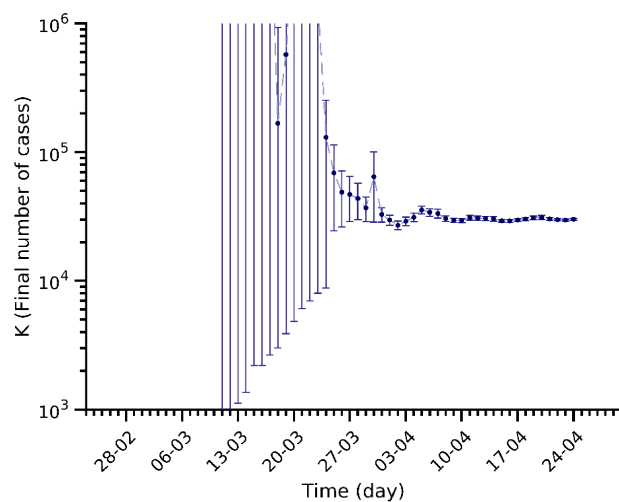
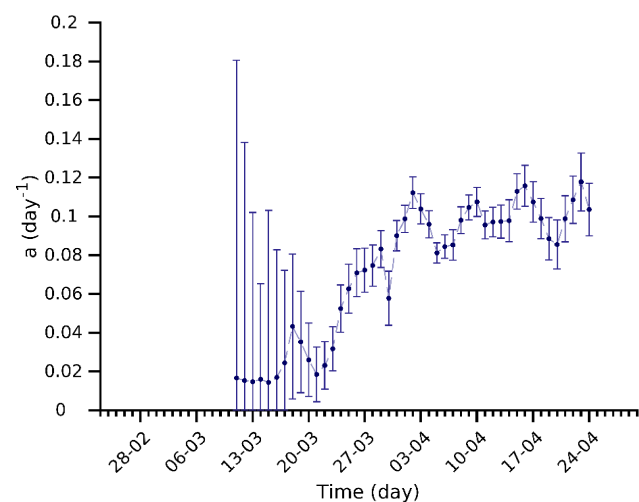
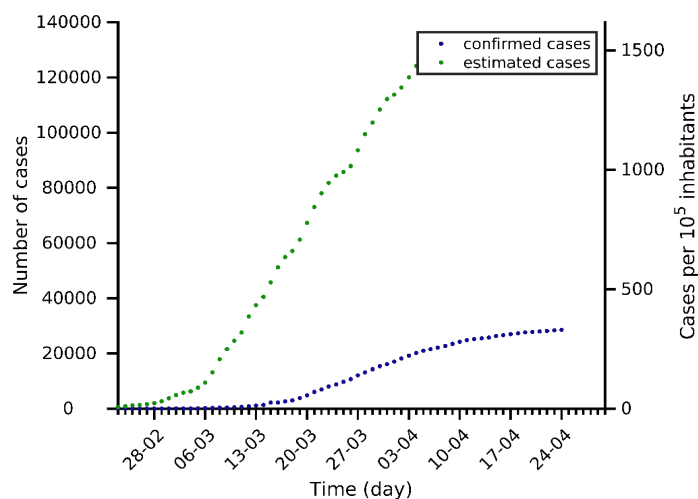
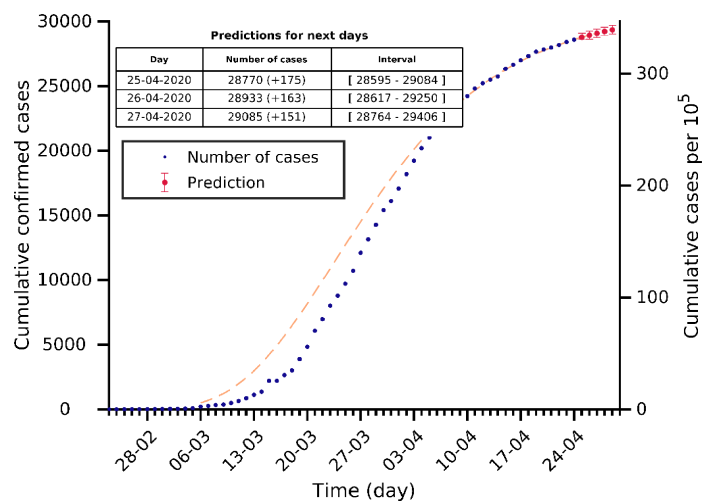
# Belgium 24-04-2020. Population: 11.6M. Current cumulated incidence: 382/10<sup>5</sup>



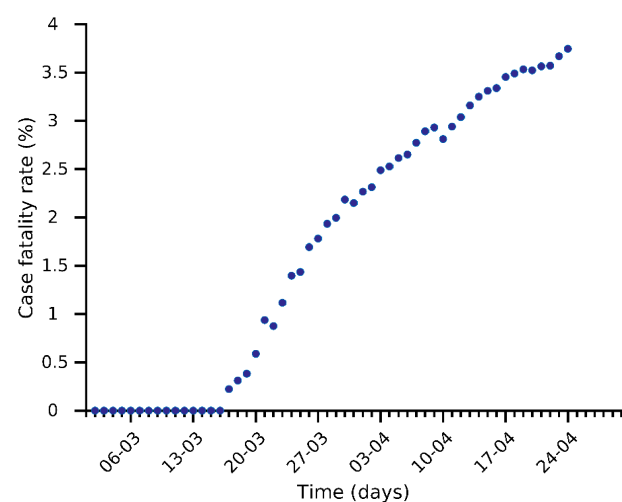
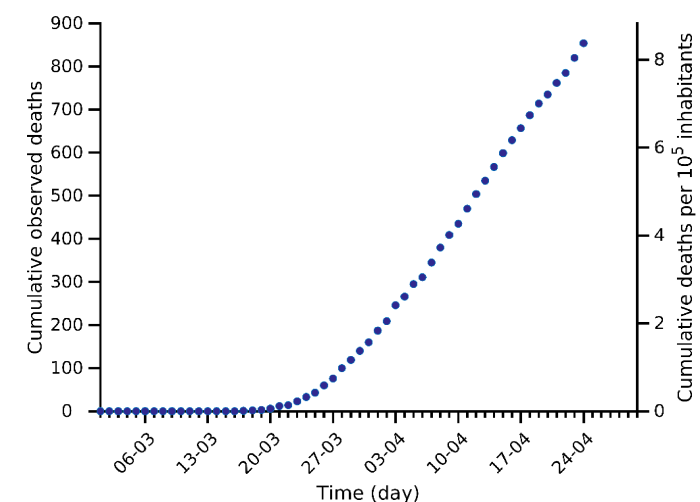
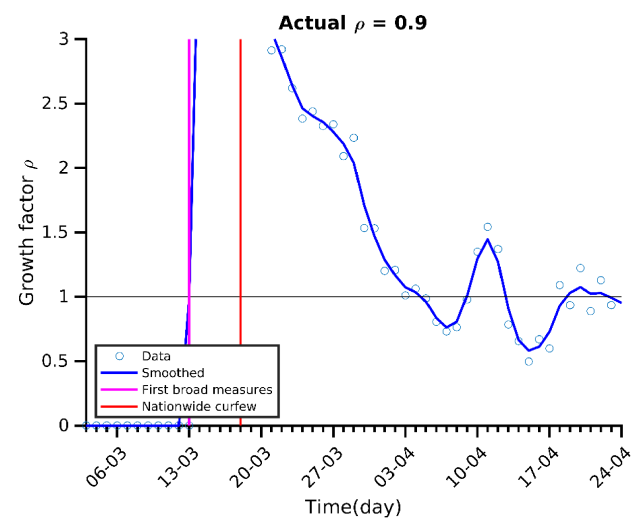
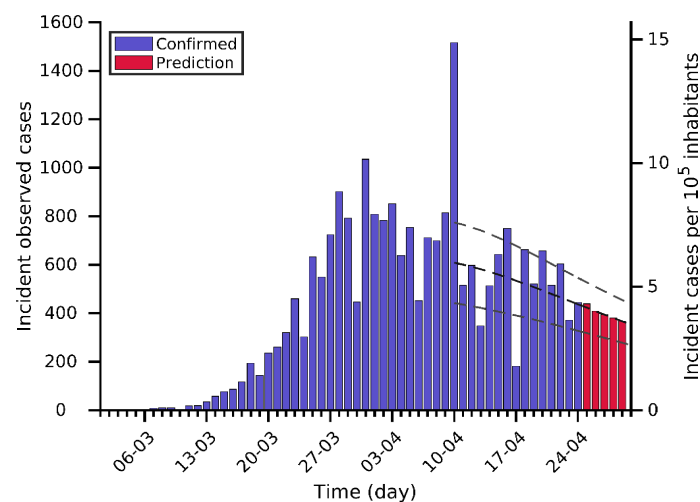
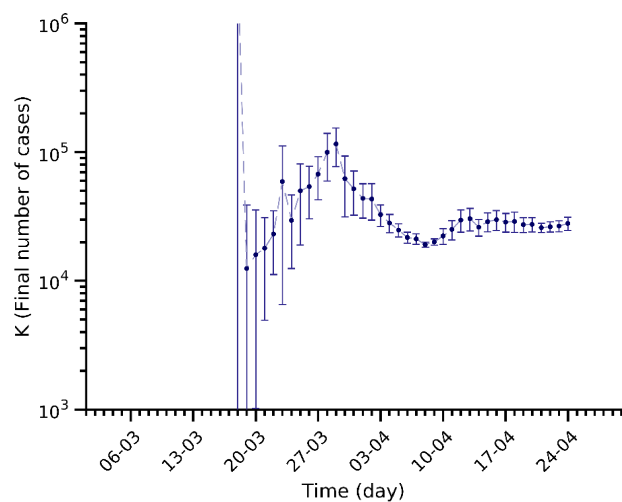
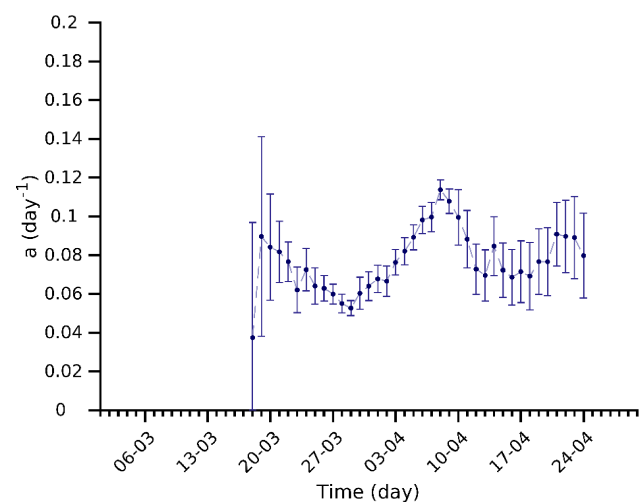
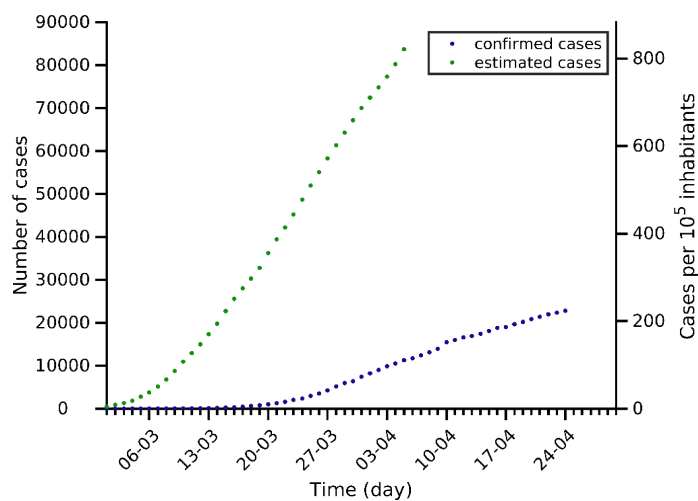
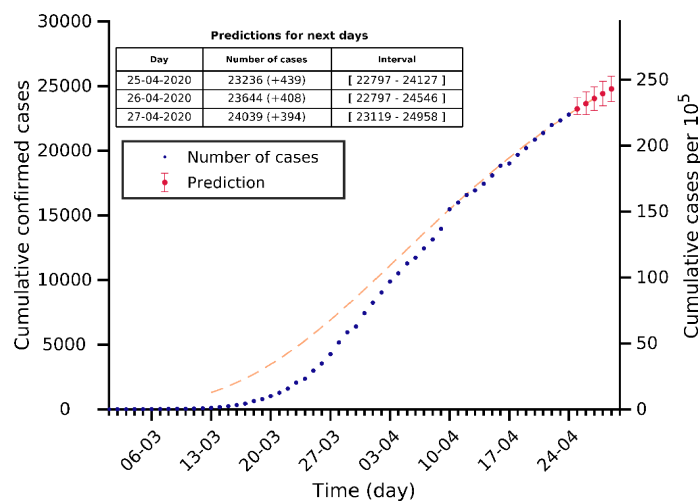
# Netherlands 24-04-2020. Population: 17.1M. Current cumulated incidence: 213/10<sup>5</sup>



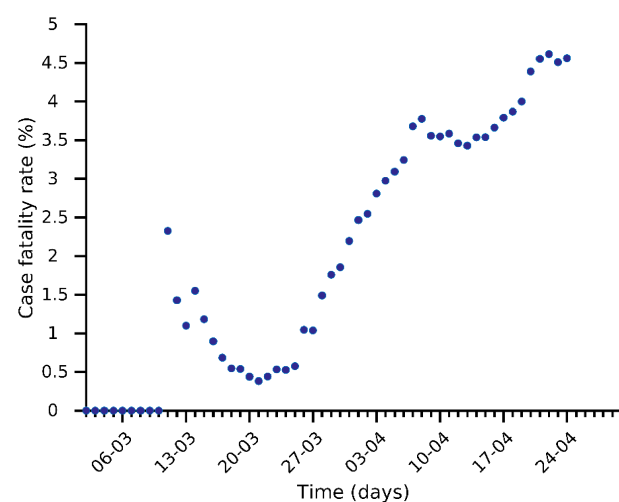
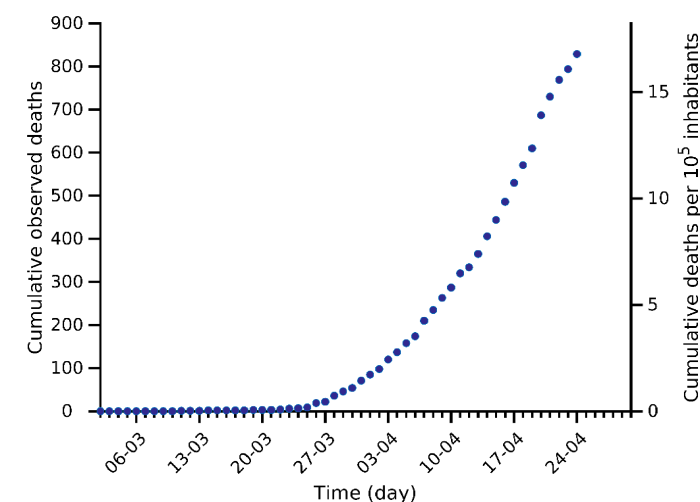
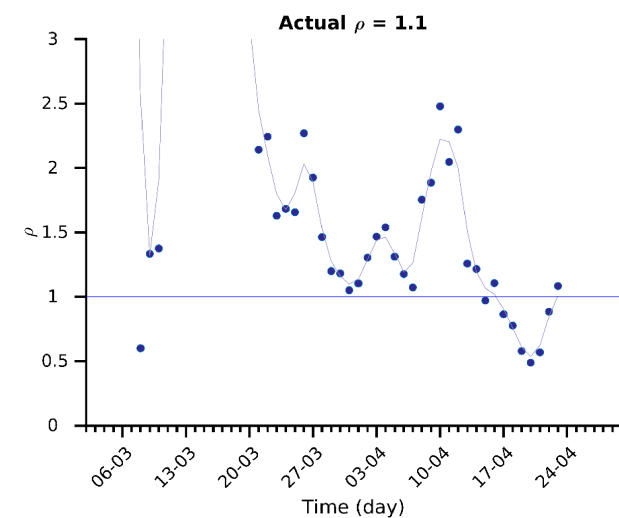
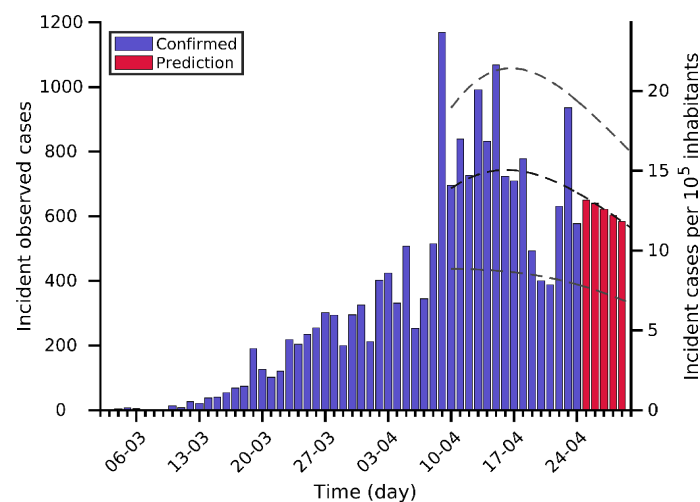
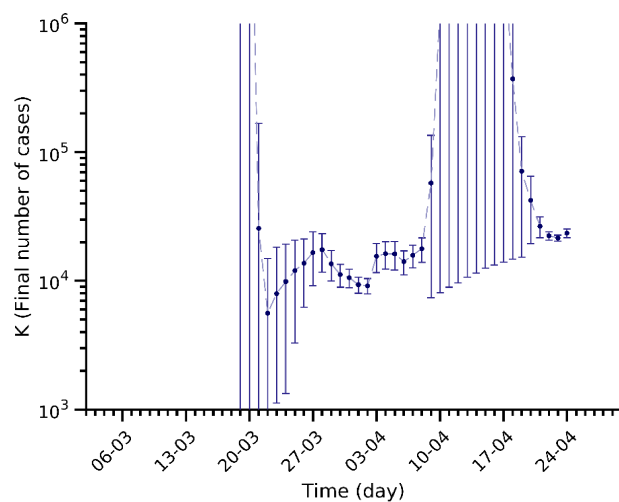
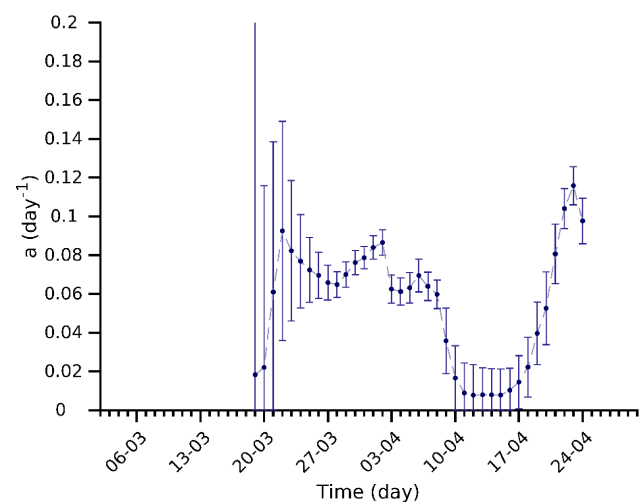
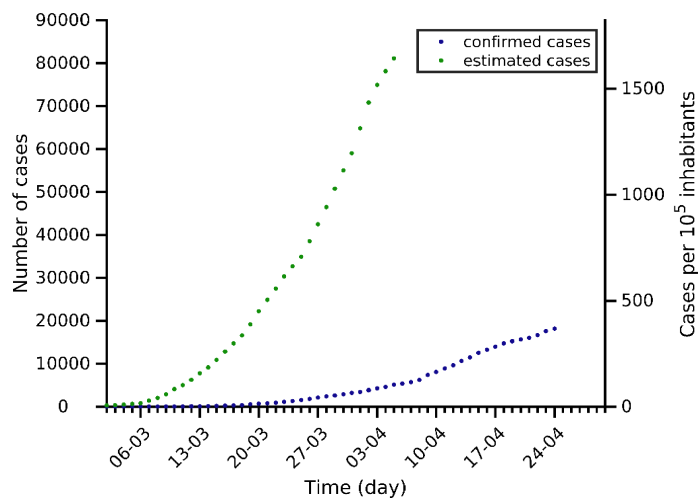
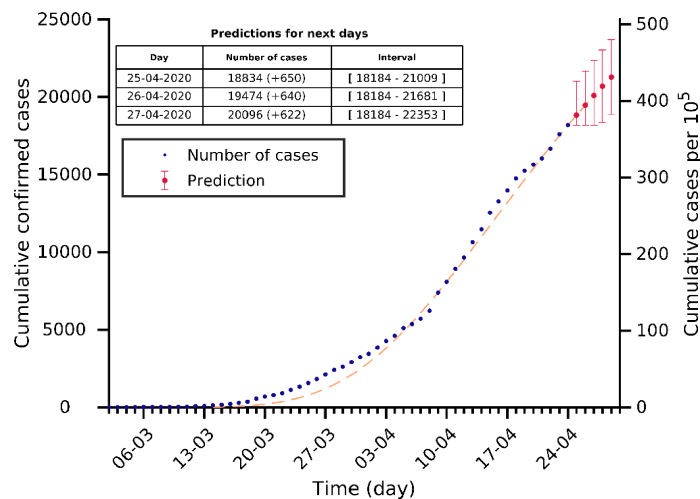
# Switzerland 24-04-2020. Population: 8.7M. Current cumulated incidence: 330/10<sup>5</sup>



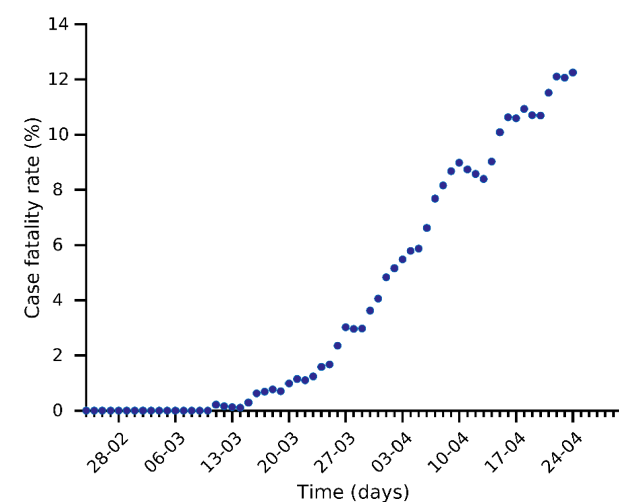
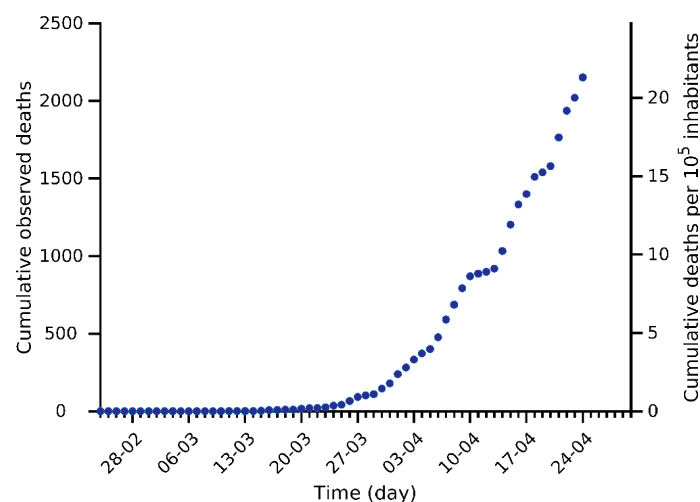
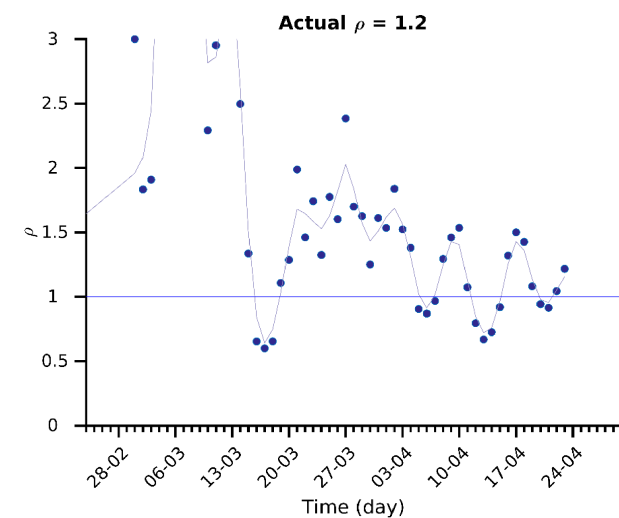
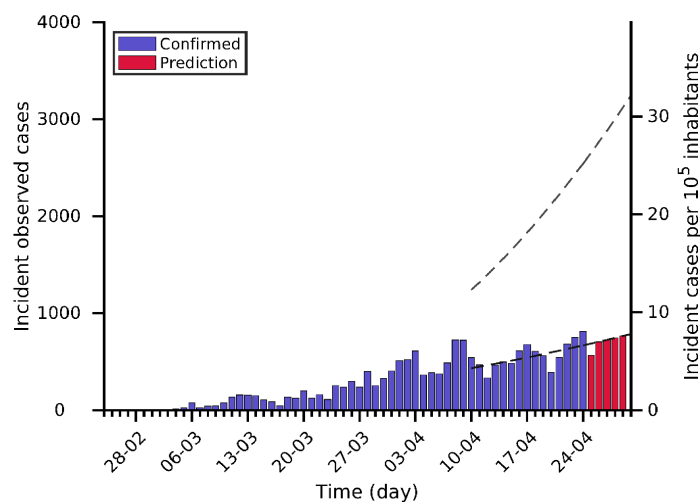
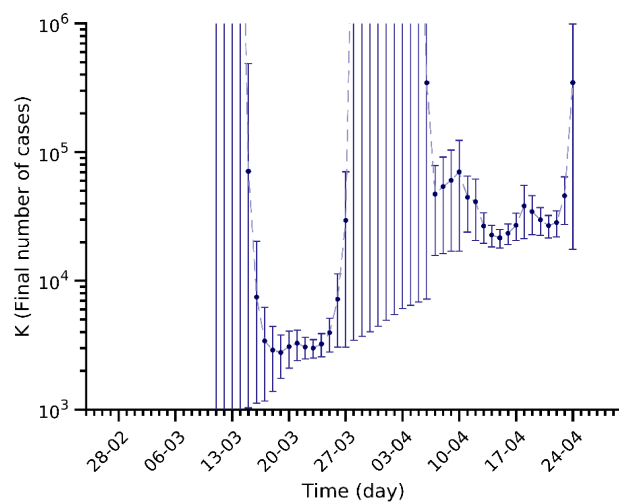
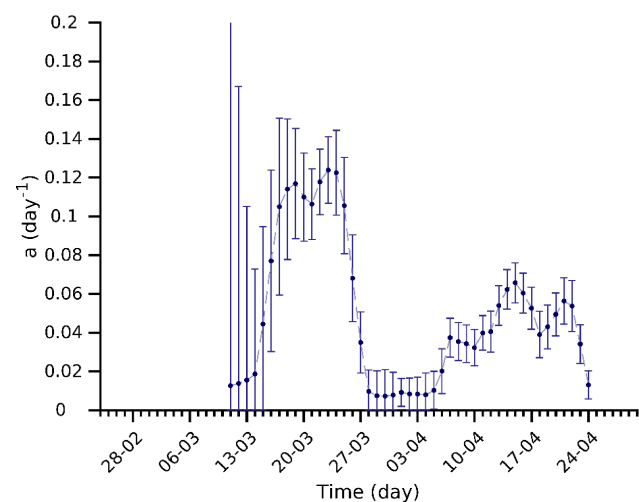
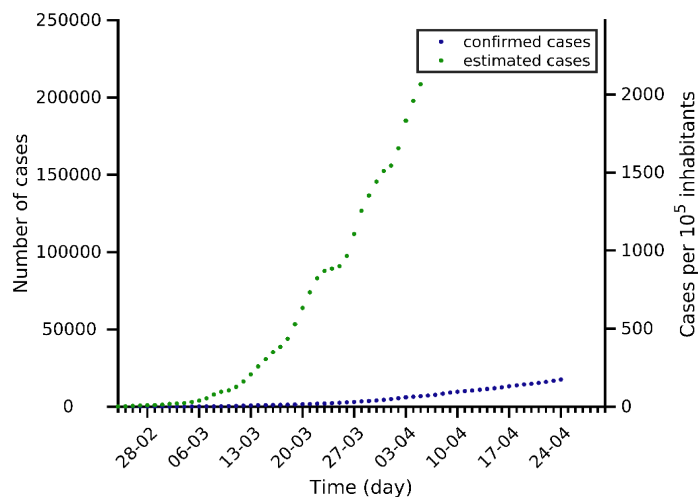
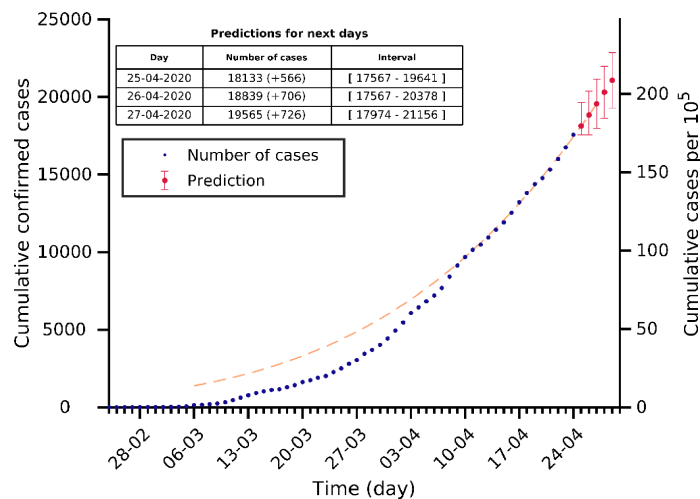
# Portugal 24-04-2020. Population: 10.2M. Current cumulated incidence: 224/10<sup>5</sup>



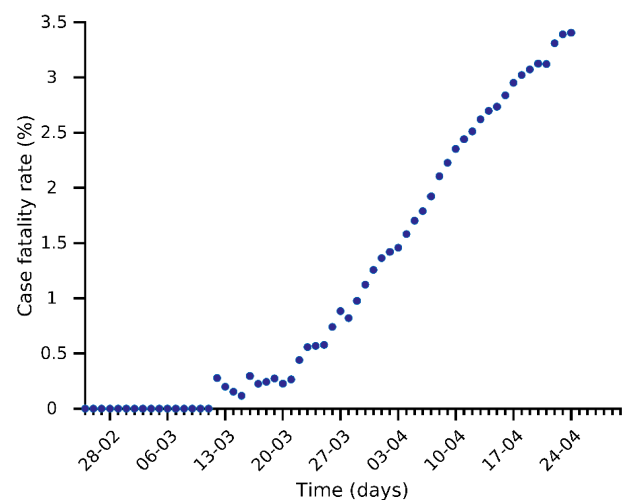
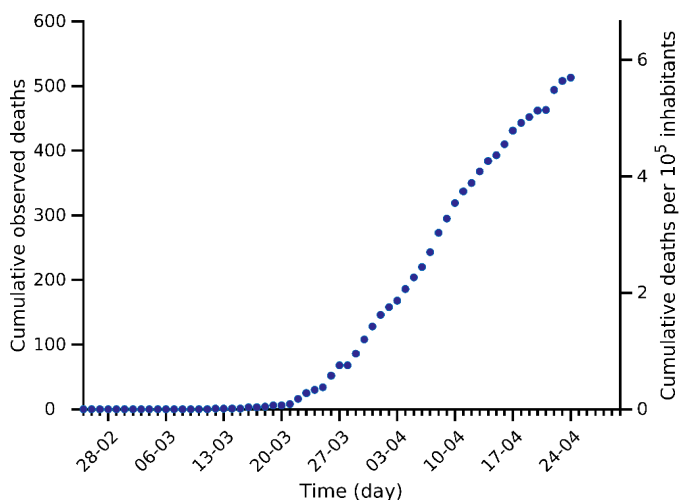
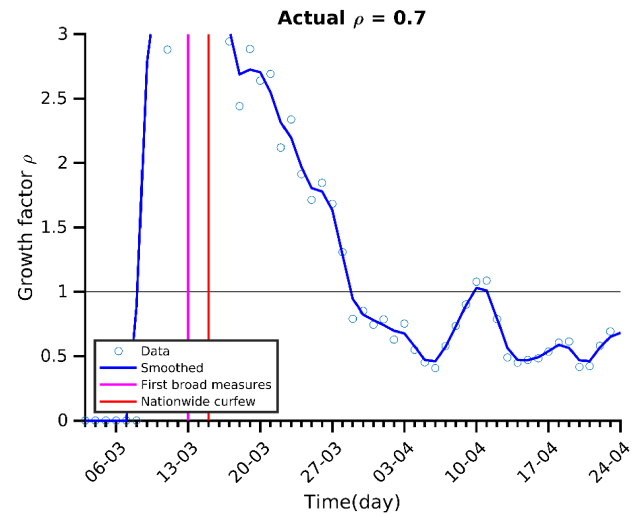
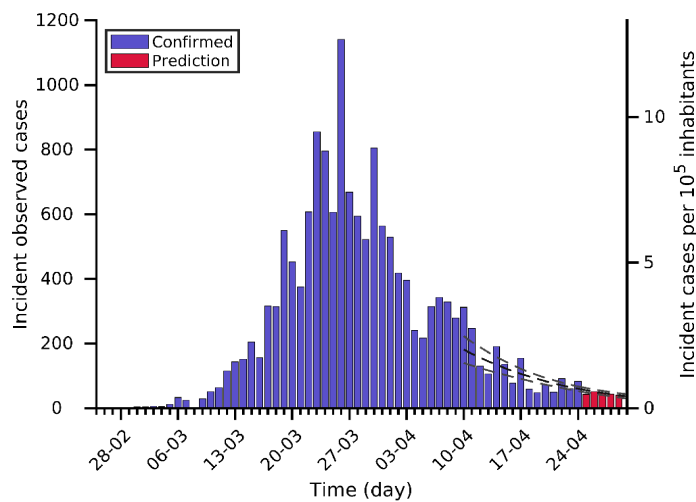
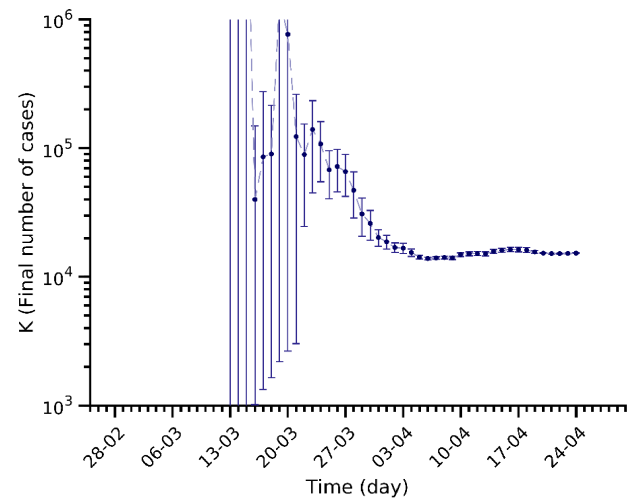
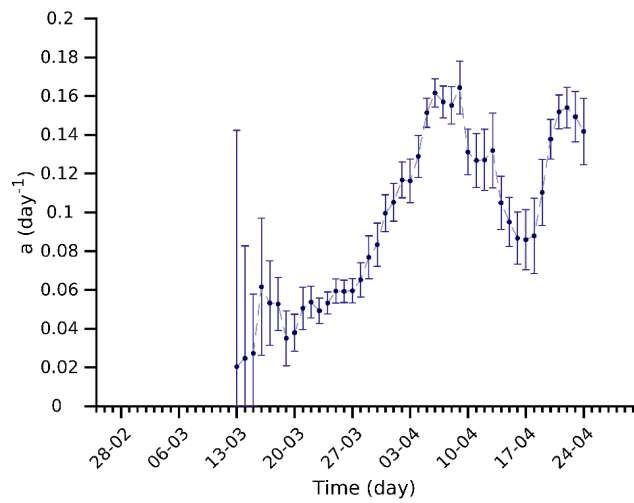
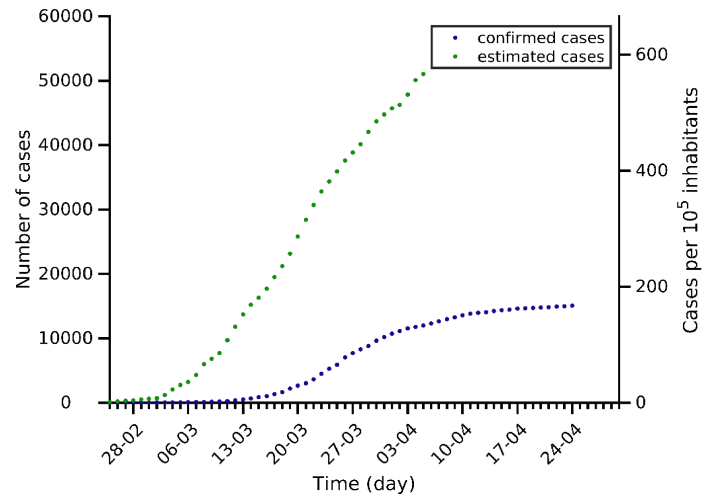
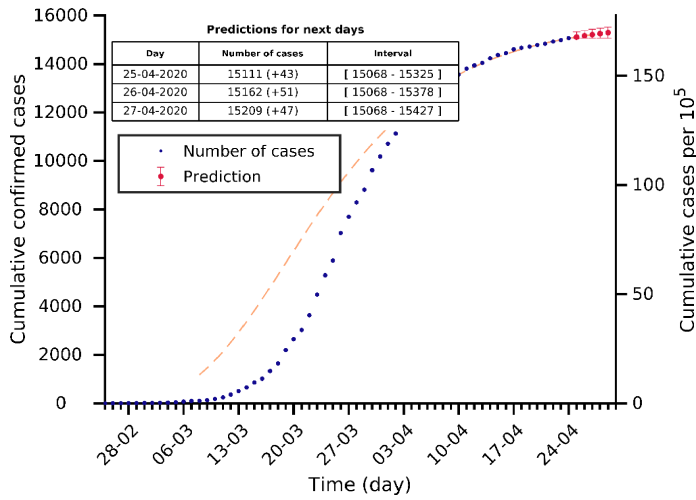
# Ireland 24-04-2020. Population: 4.9M. Current cumulated incidence: 368/10<sup>5</sup>



# Sweden 24-04-2020. Population: 10.1M. Current cumulated incidence: 174/10<sup>5</sup>

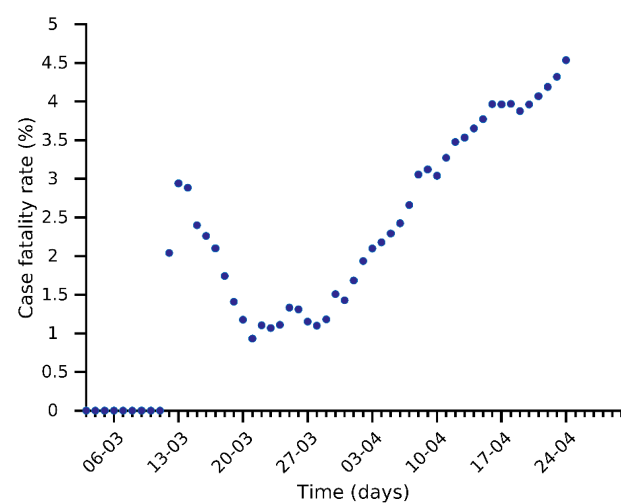
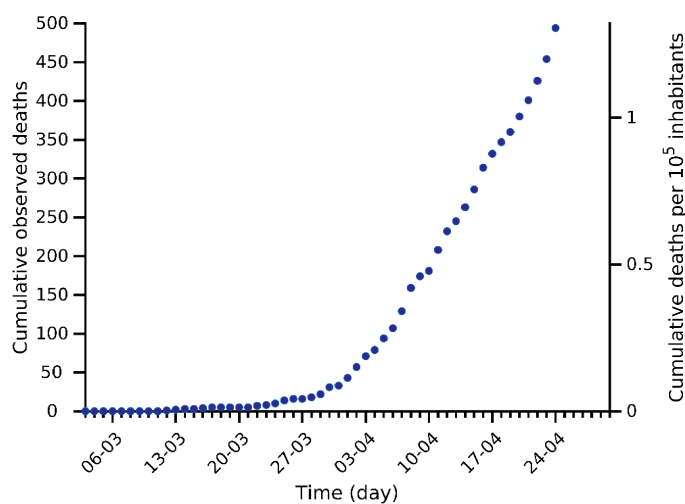
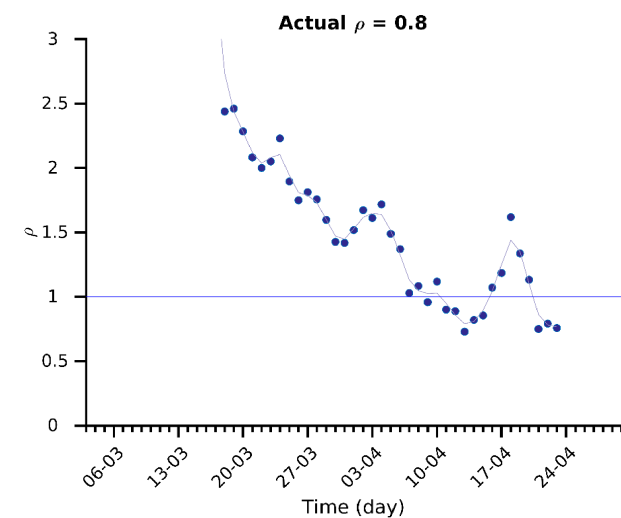
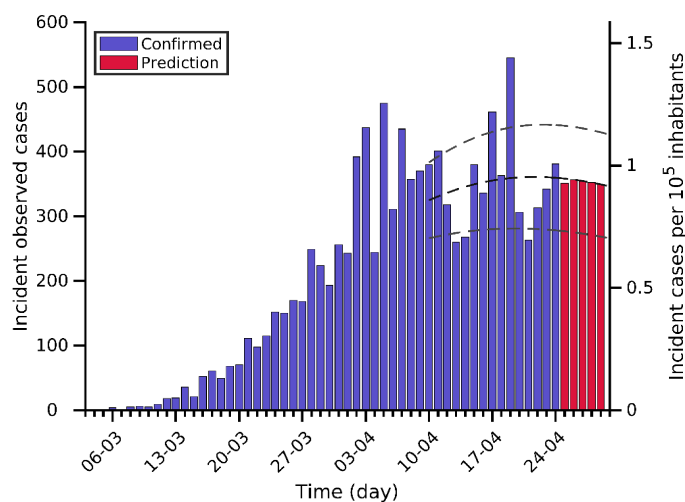
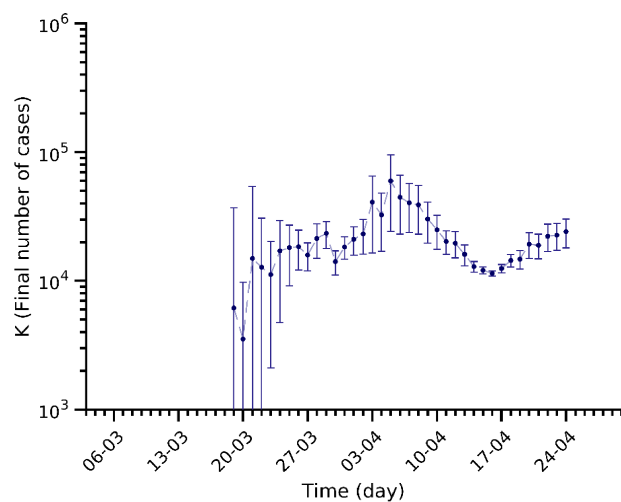
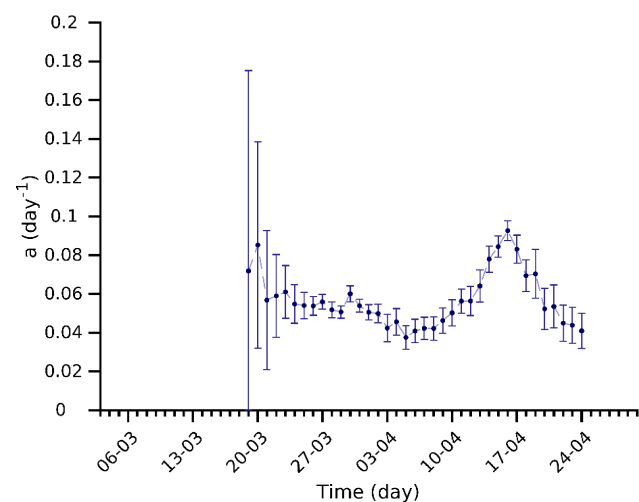
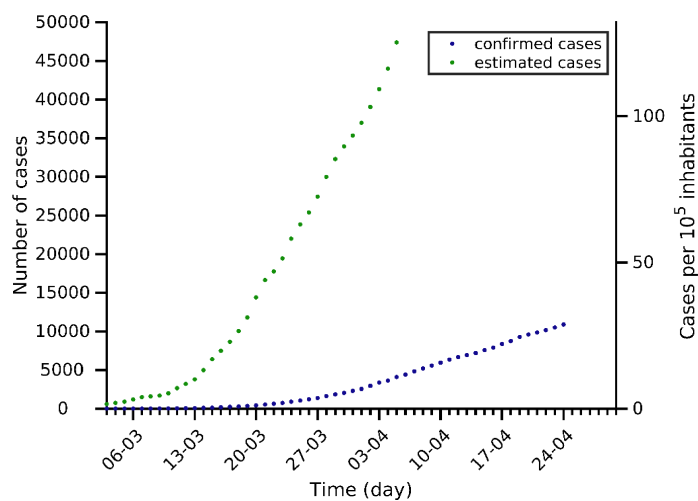
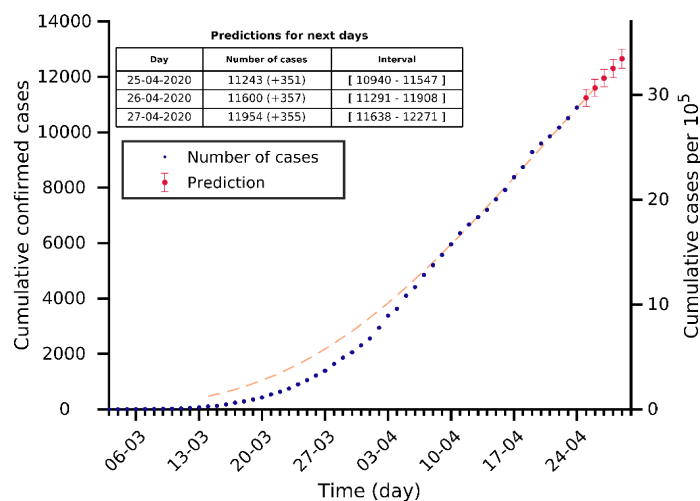


# Austria 24-04-2020. Population: 9.0M. Current cumulated incidence: 167/10<sup>5</sup>

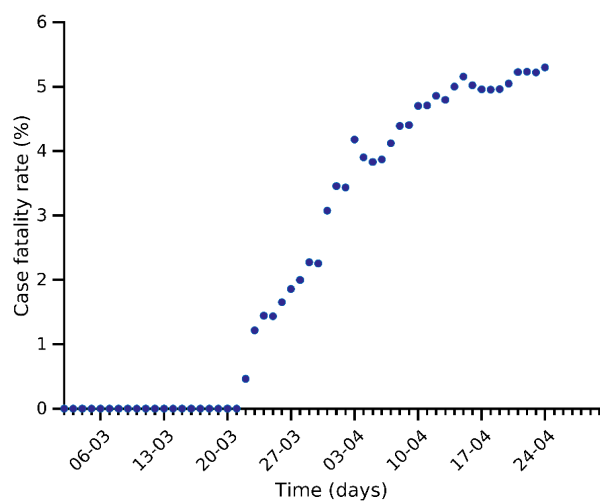
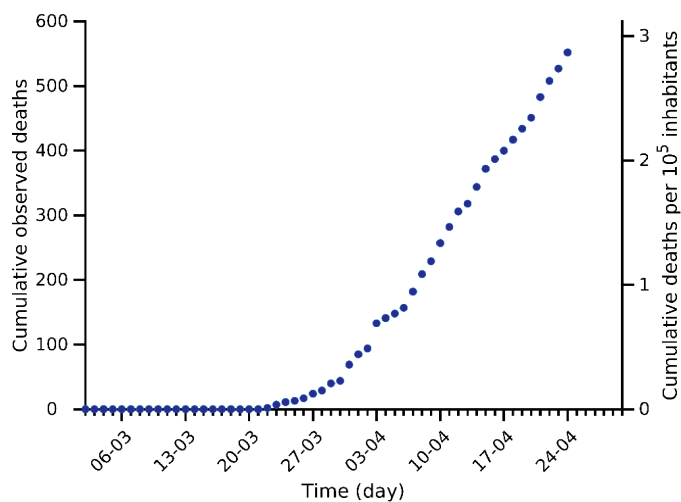
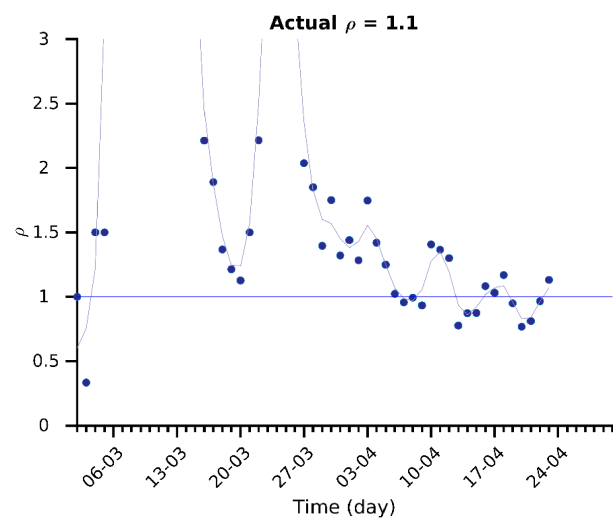
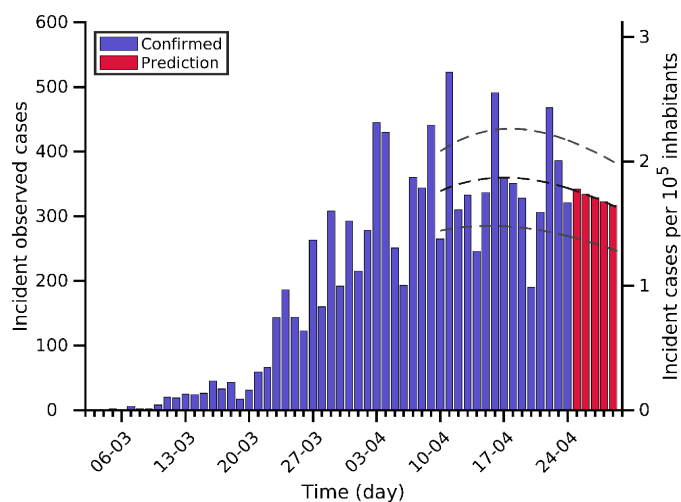
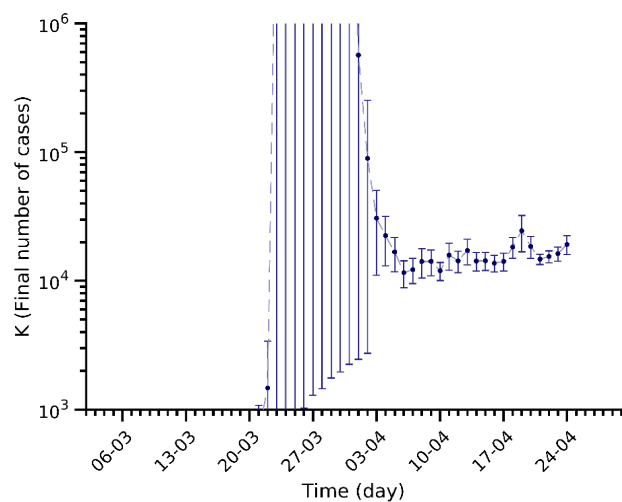
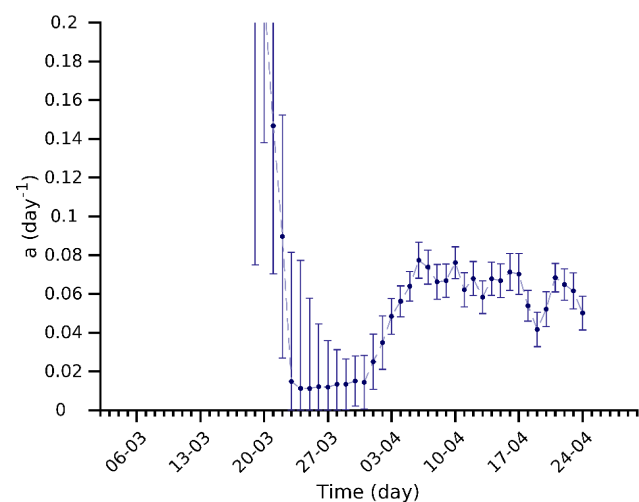
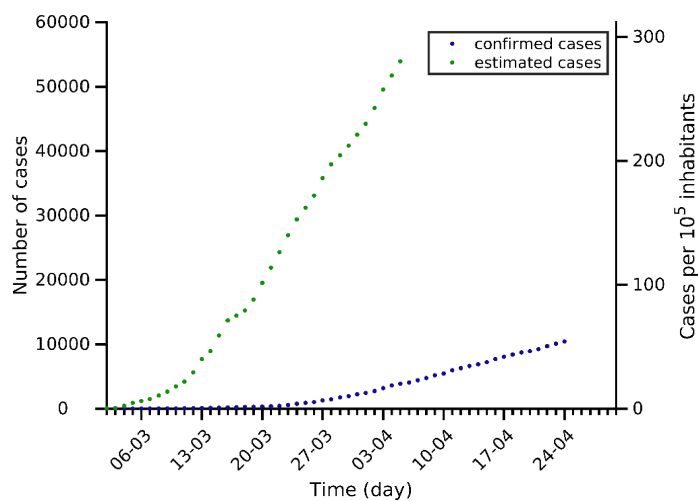
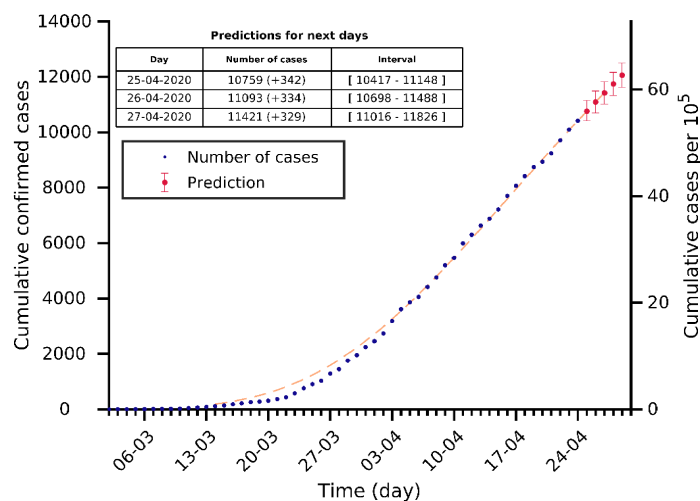




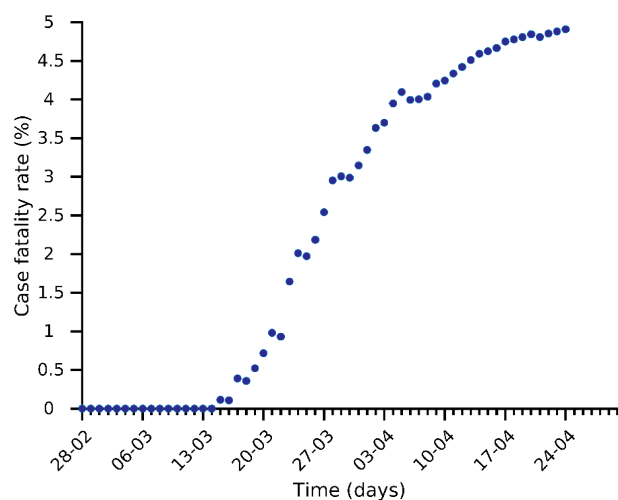
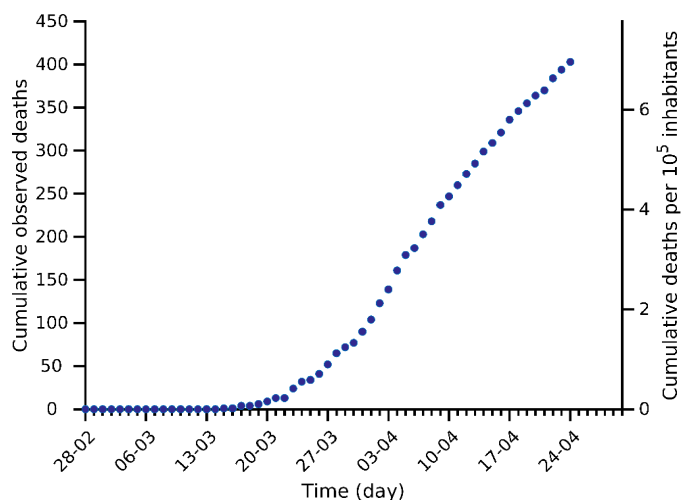
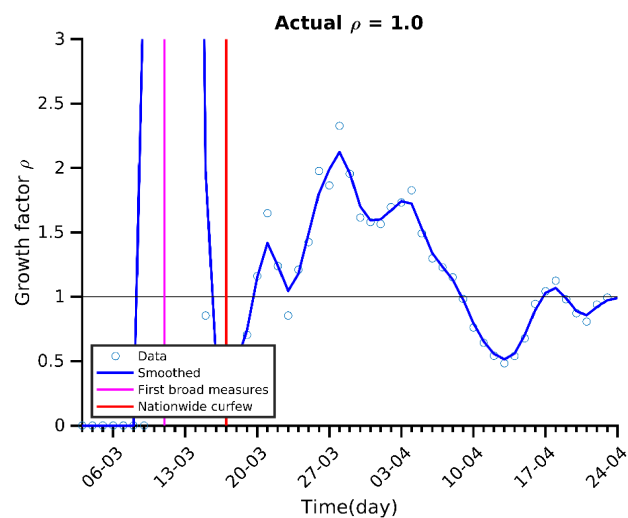
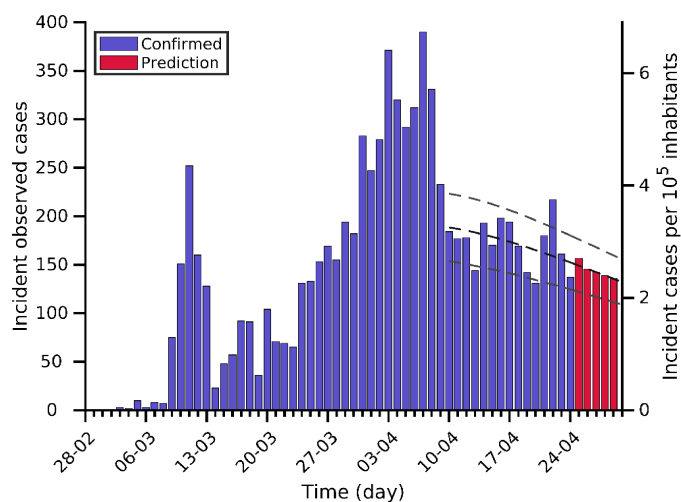
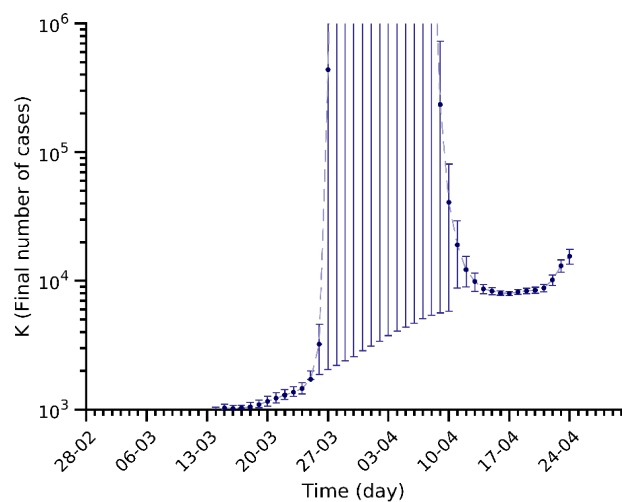
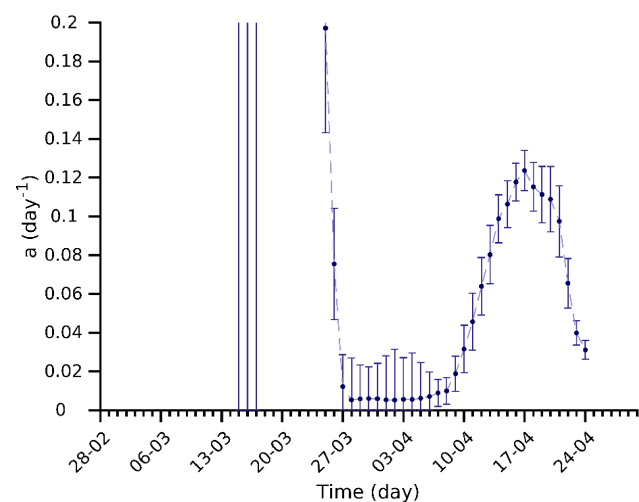
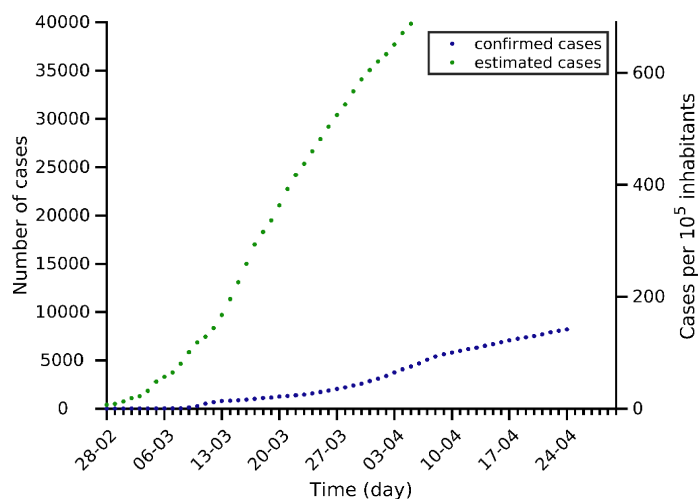
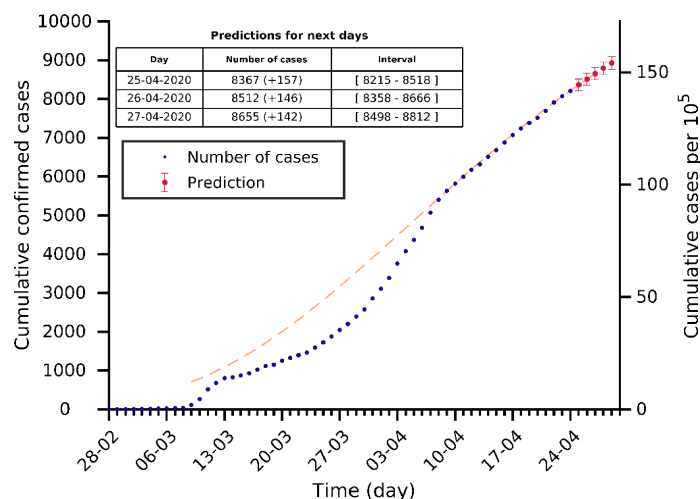
# Poland 24-04-2020. Population: 37.8M. Current cumulated incidence: 29/10<sup>5</sup>



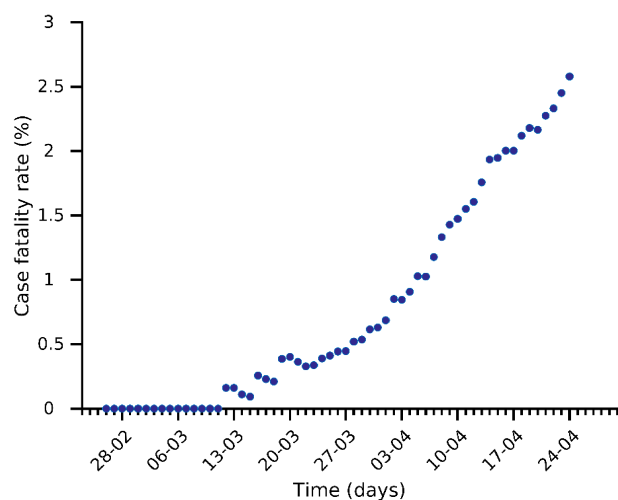
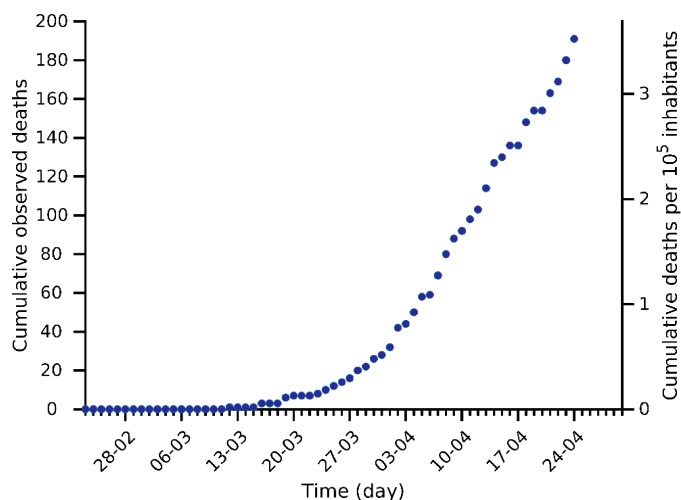
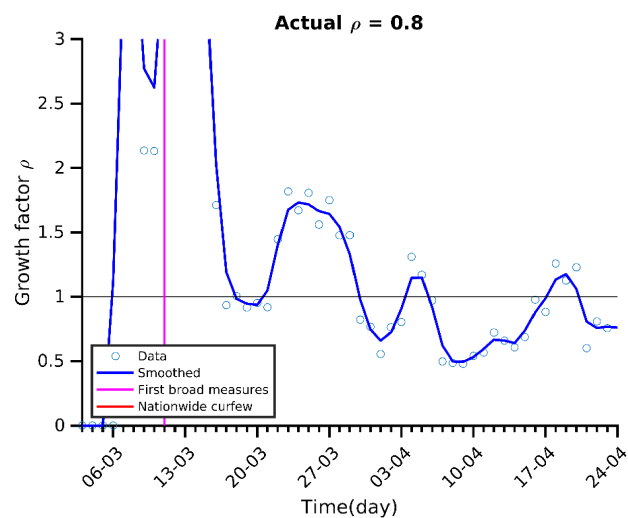
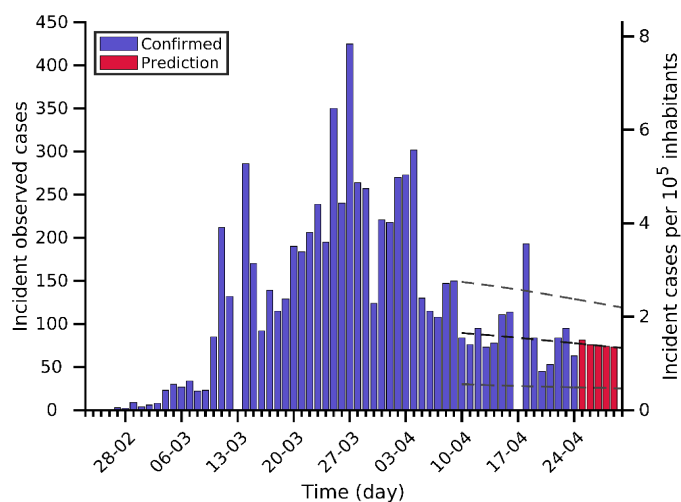
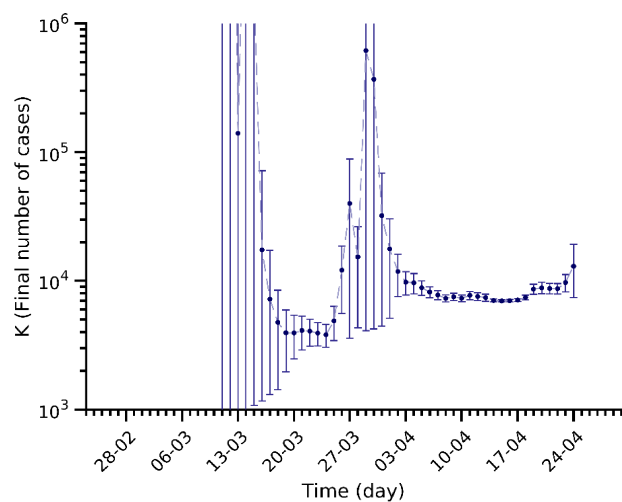
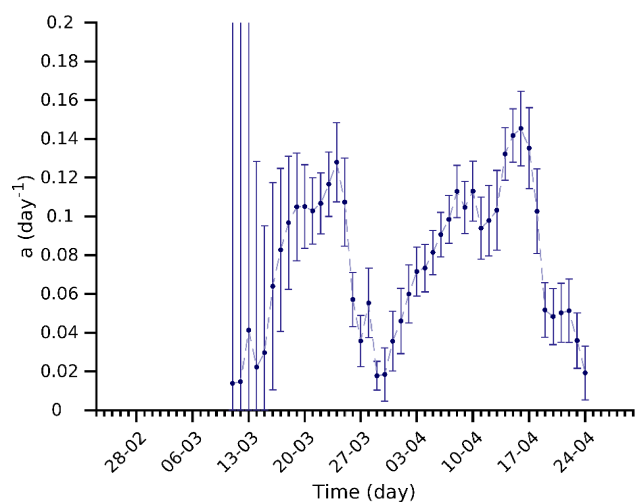
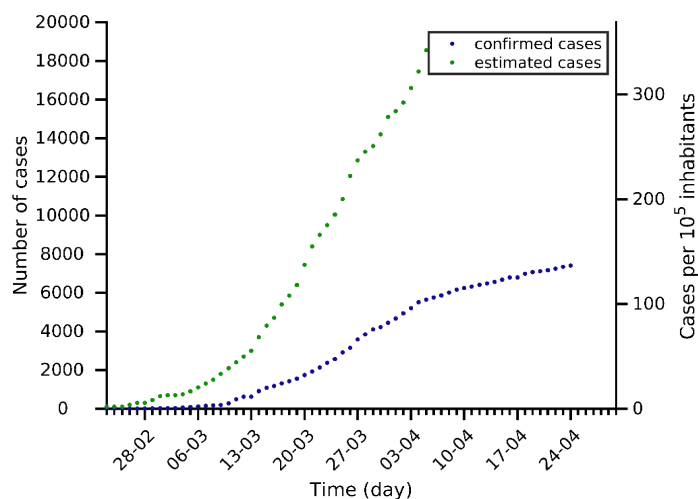
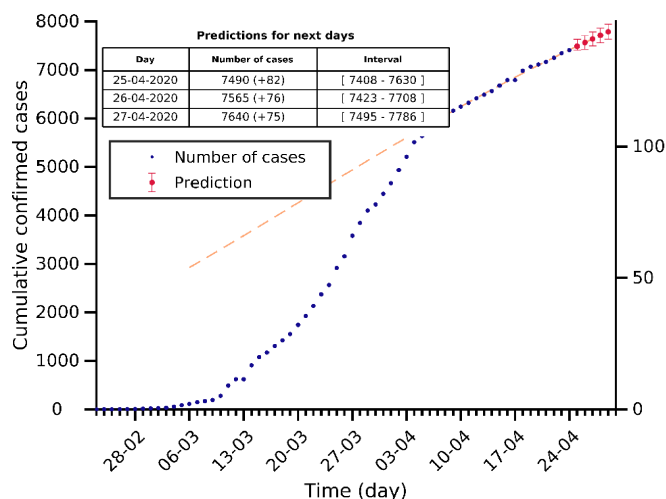
# Romania 24-04-2020. Population: 19.2M. Current cumulated incidence: 54/10<sup>5</sup>



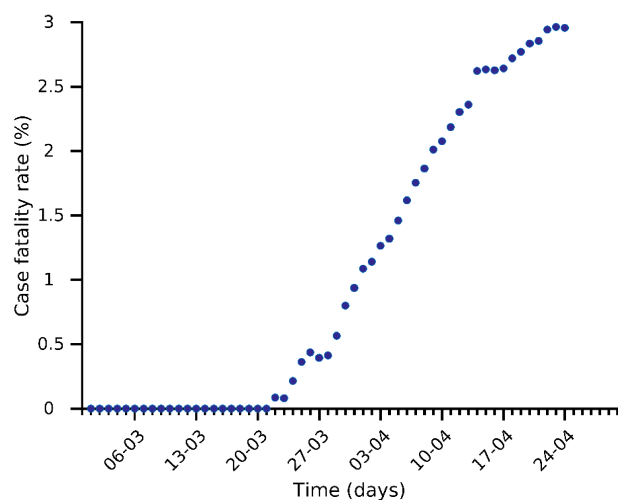
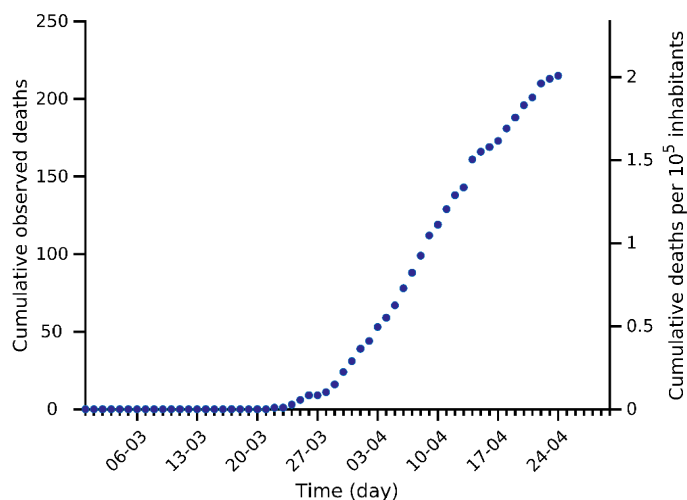
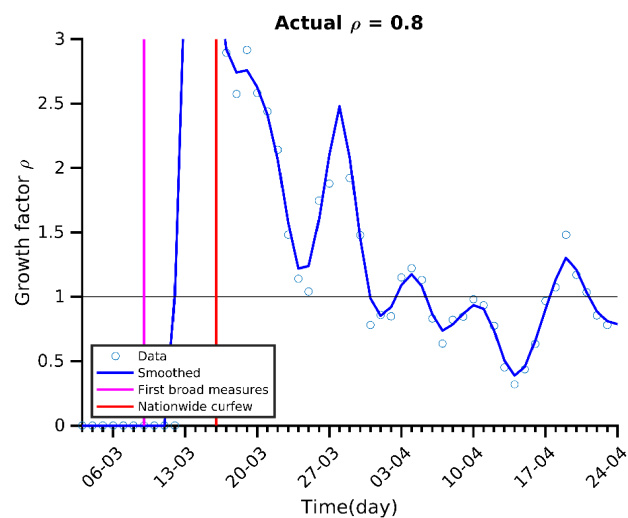
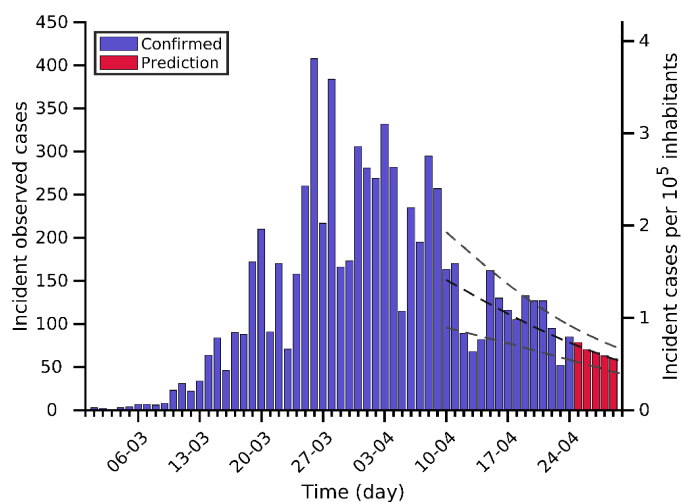
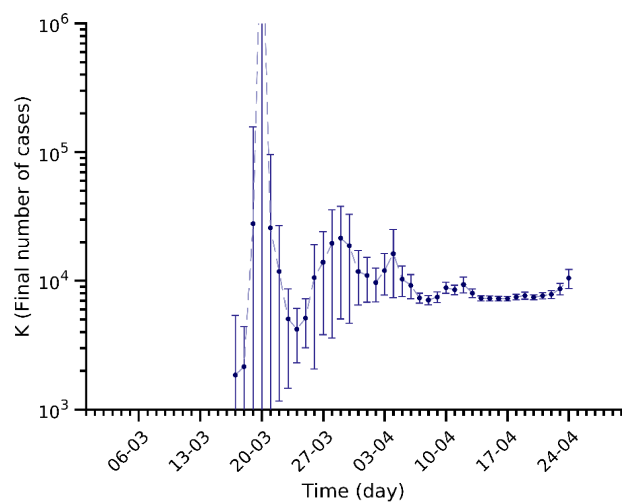
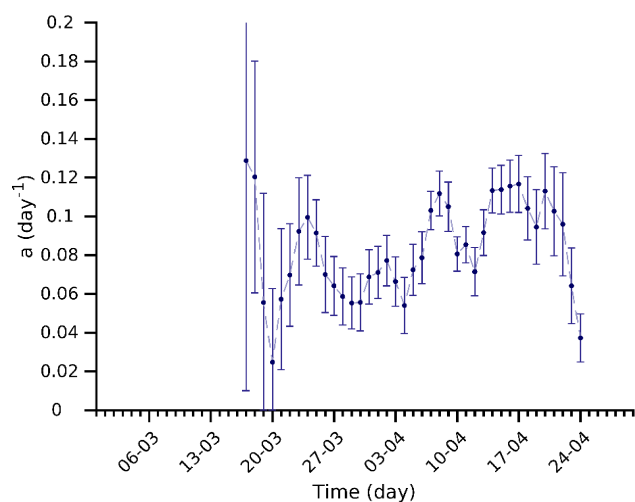
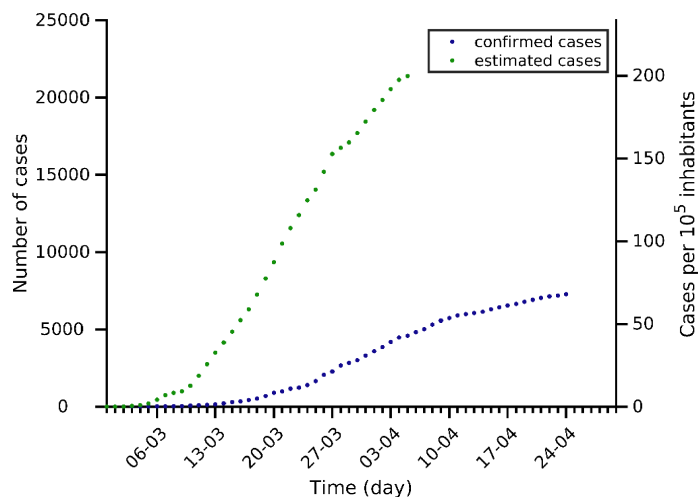
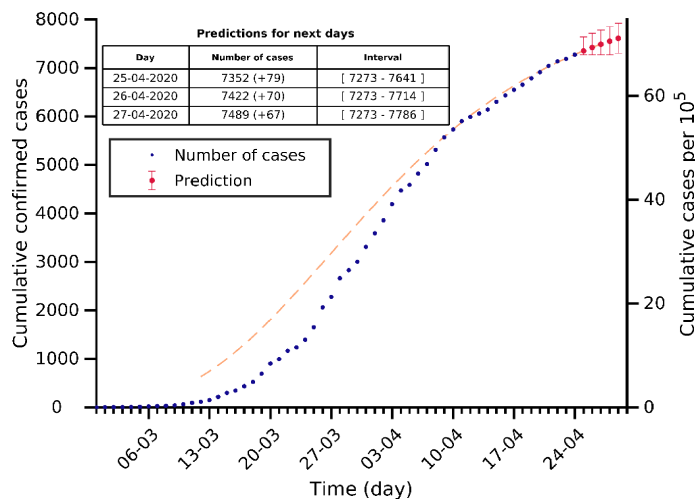
# Denmark 24-04-2020. Population: 5.8M. Current cumulated incidence: 142/10<sup>5</sup>



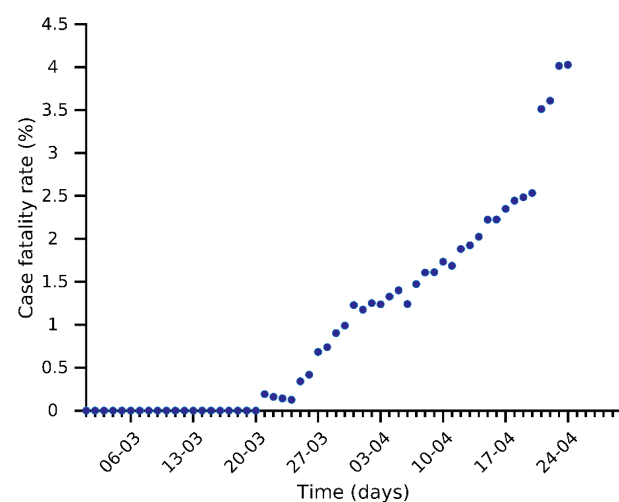
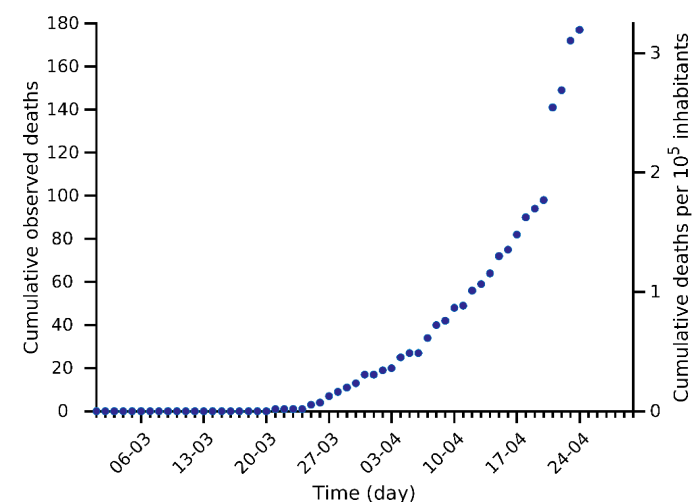
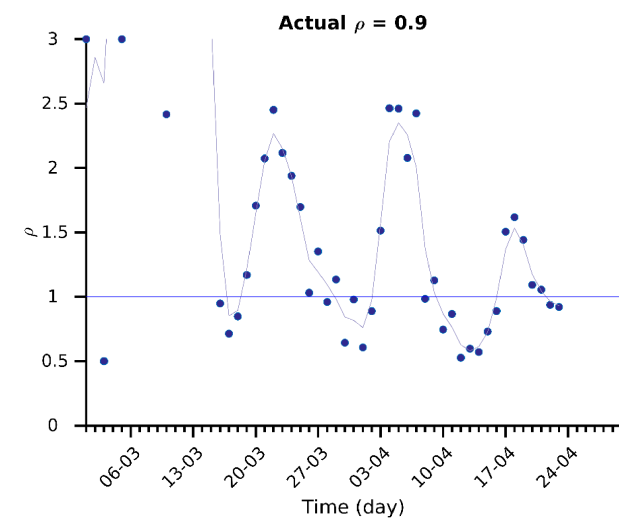
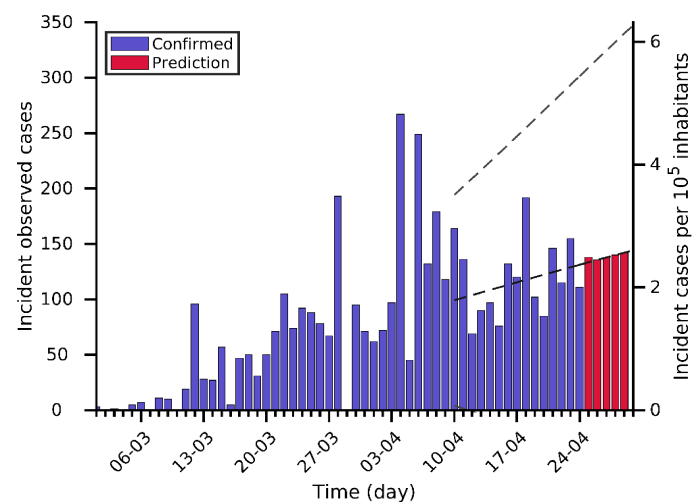
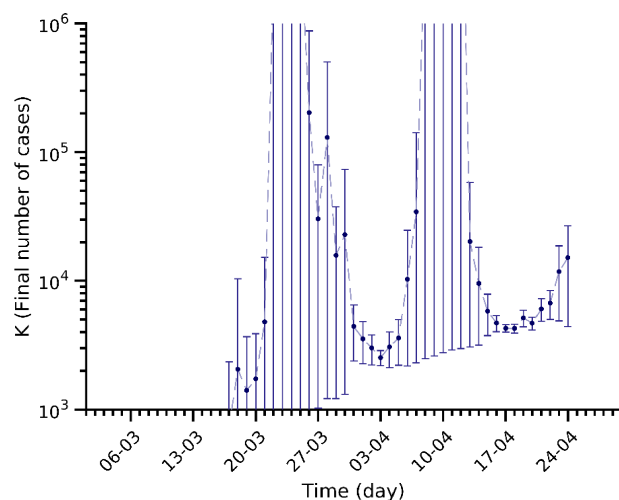
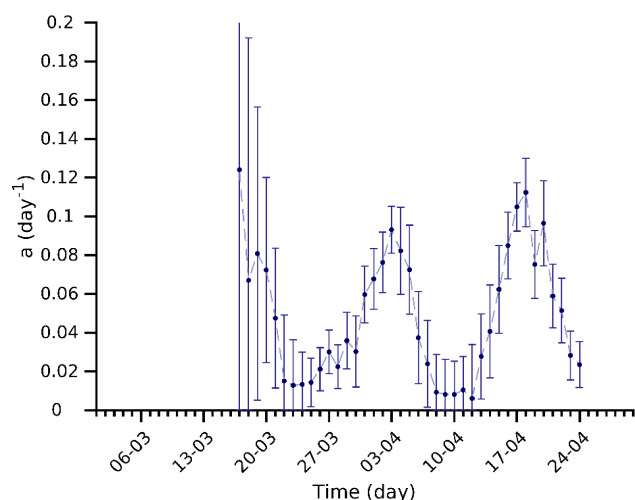
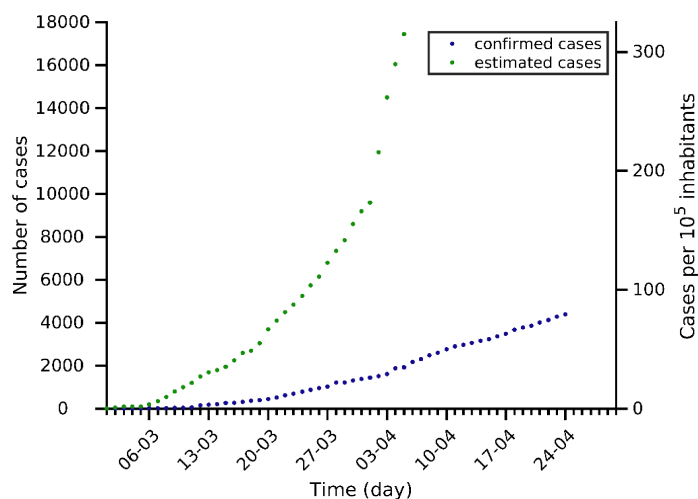
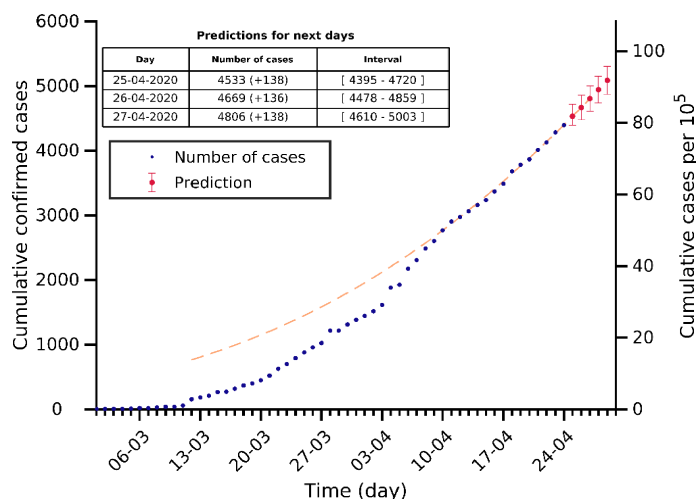
# Norway 24-04-2020. Population: 5.4M. Current cumulated incidence: 137/10<sup>5</sup>



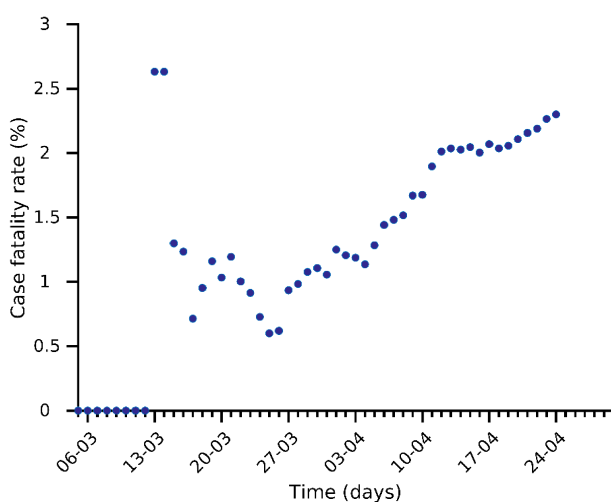
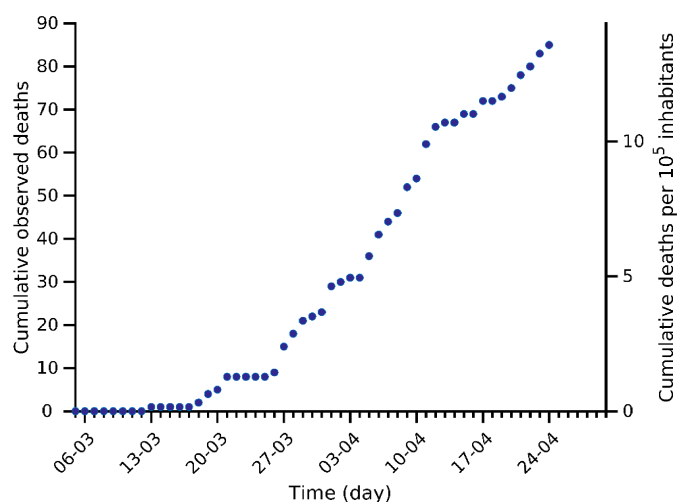
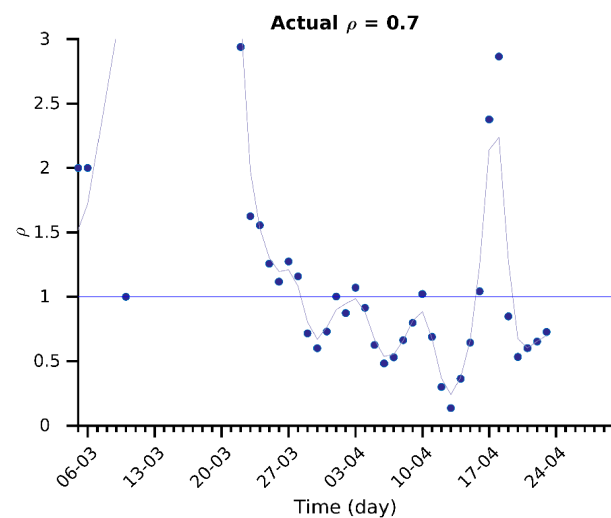
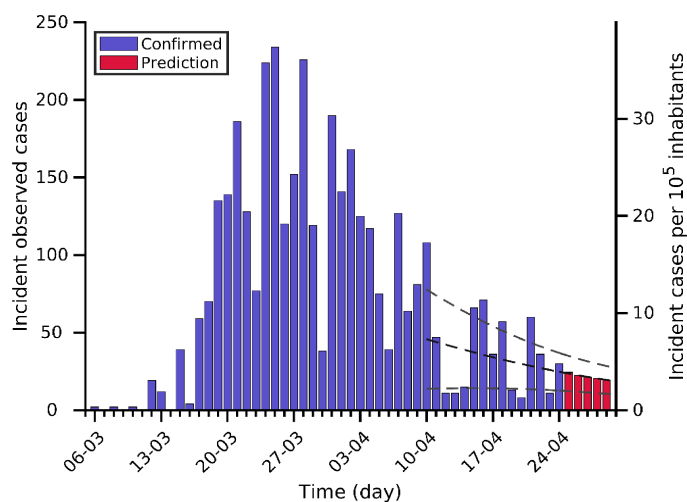
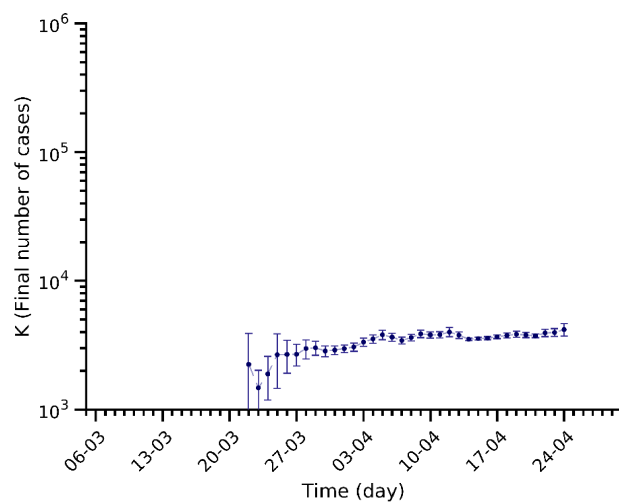
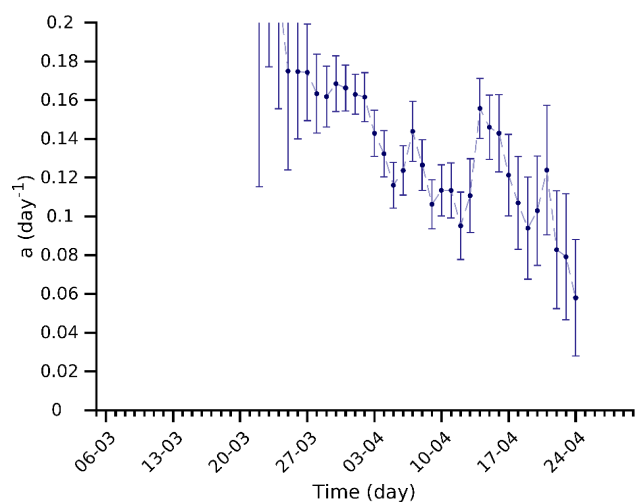
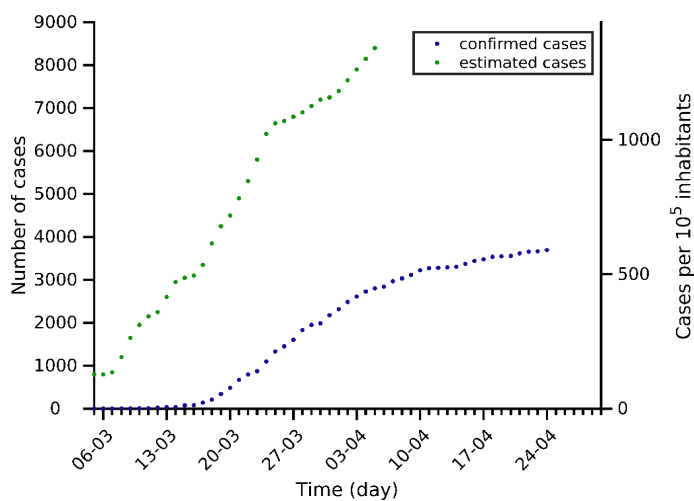
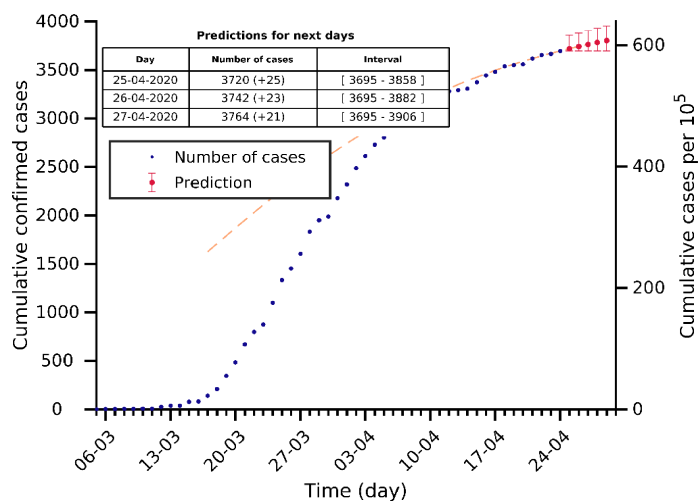
# Czech Rep 24-04-2020. Population: 10.7M. Current cumulated incidence: 68/10<sup>5</sup>



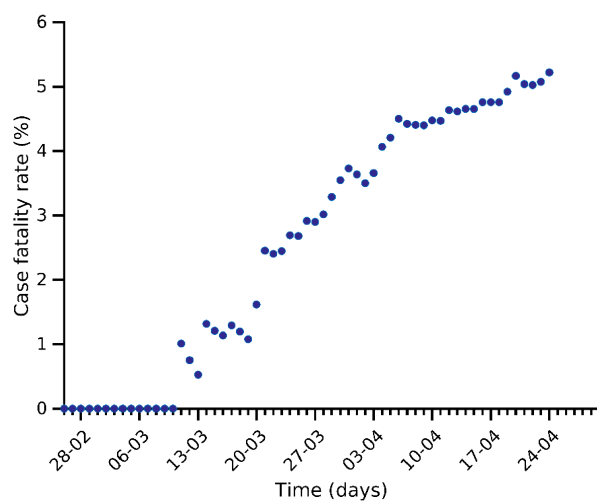
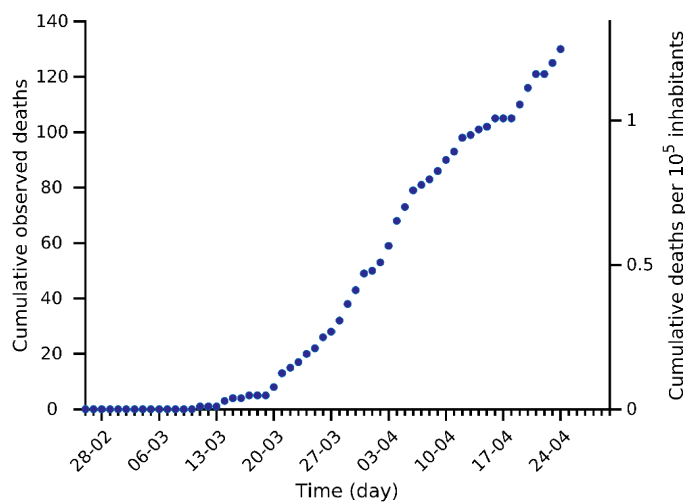
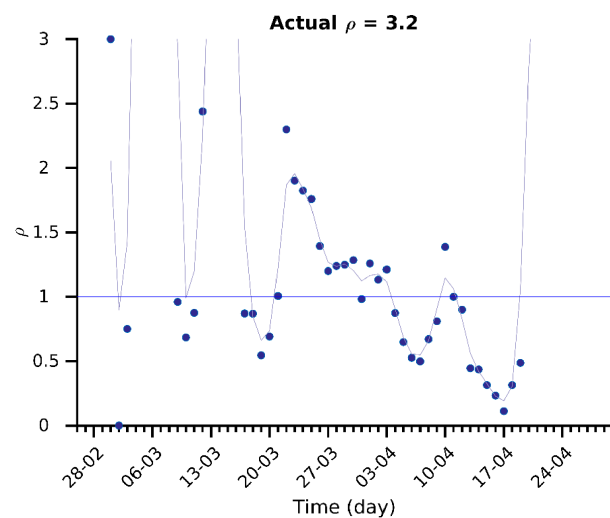
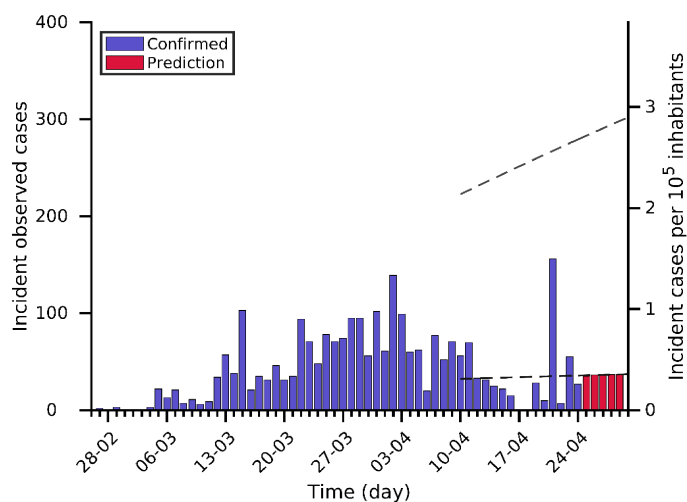
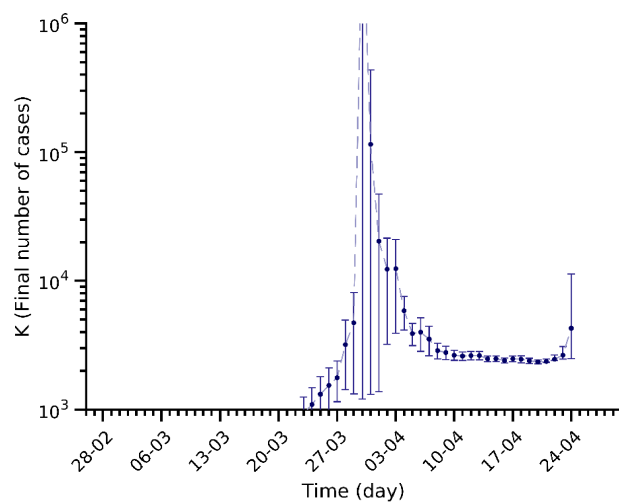
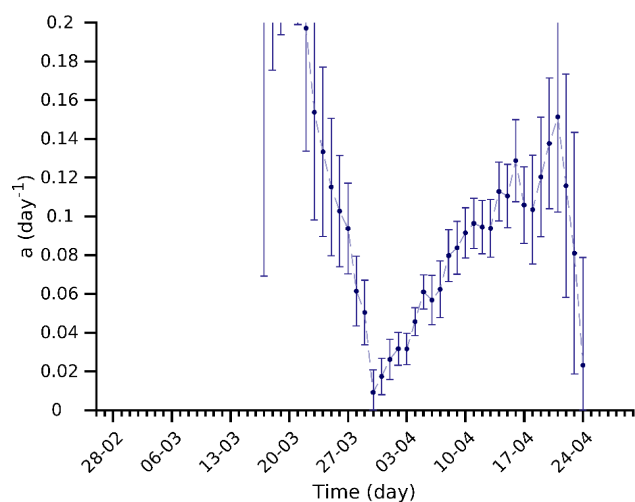
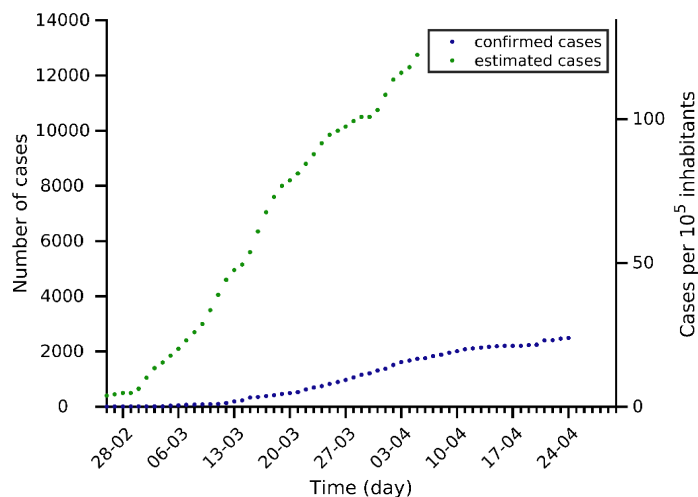
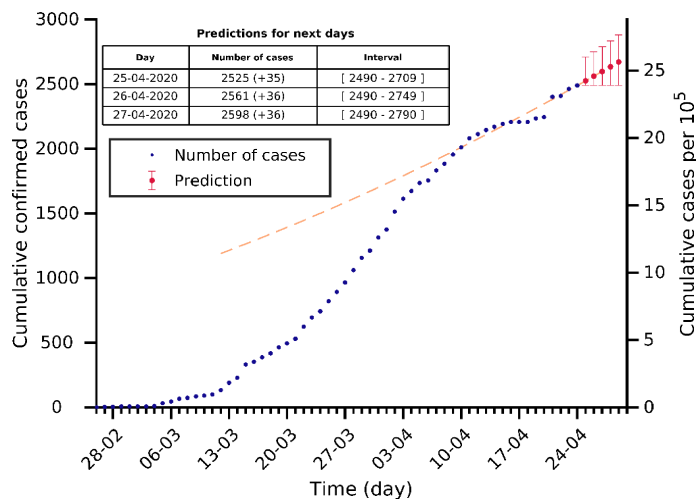
# Finland 24-04-2020. Population: 5.5M. Current cumulated incidence: 79/10<sup>5</sup>



# Luxembourg 24-04-2020. Population: 0.6M. Current cumulated incidence: 590/10<sup>5</sup>

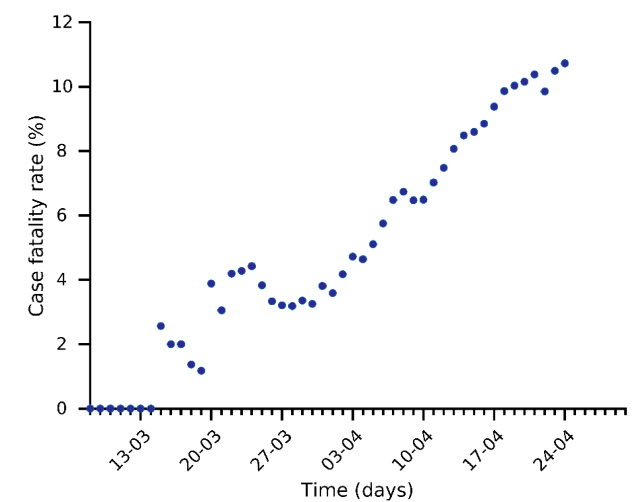
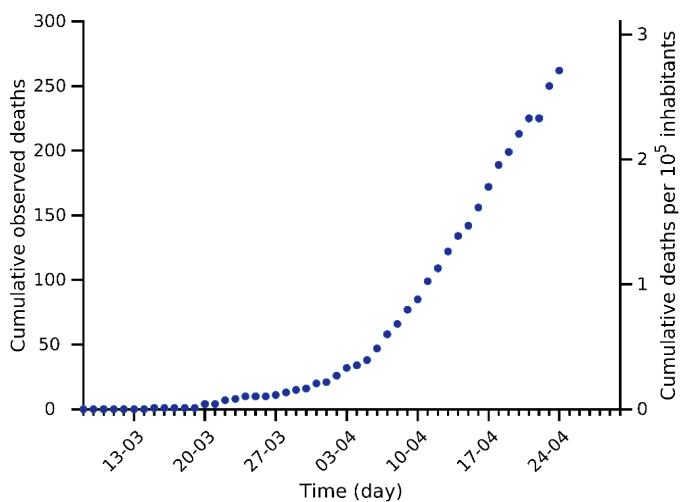
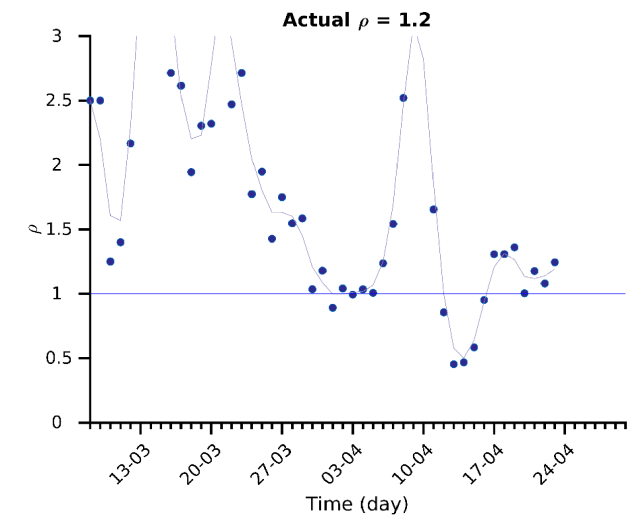
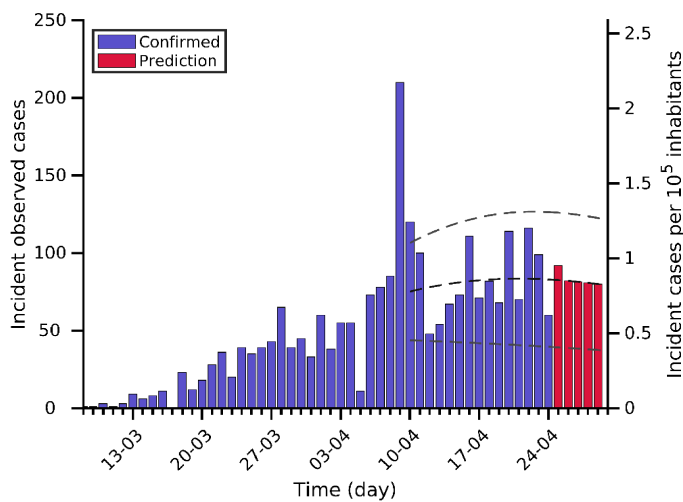
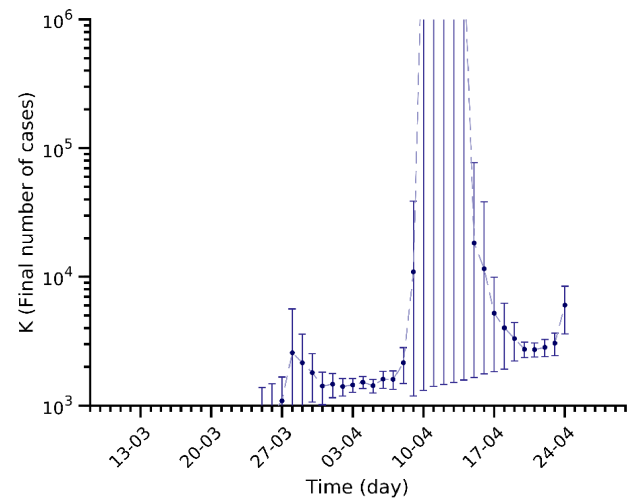
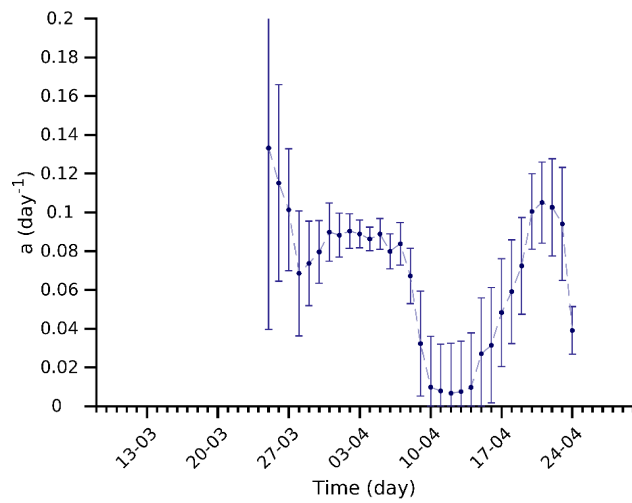
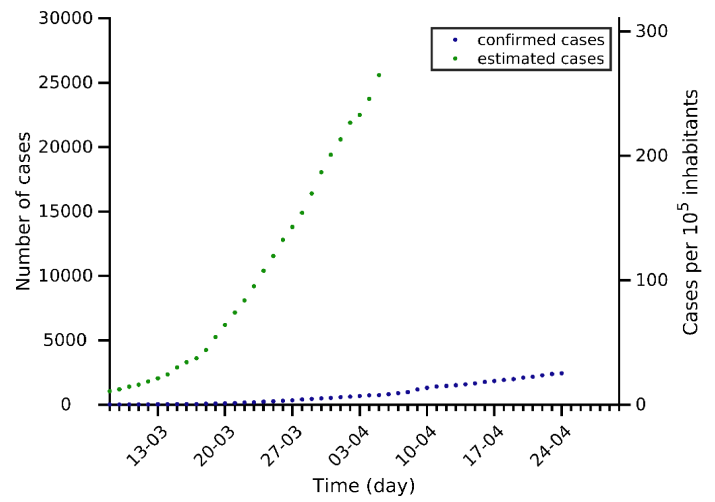
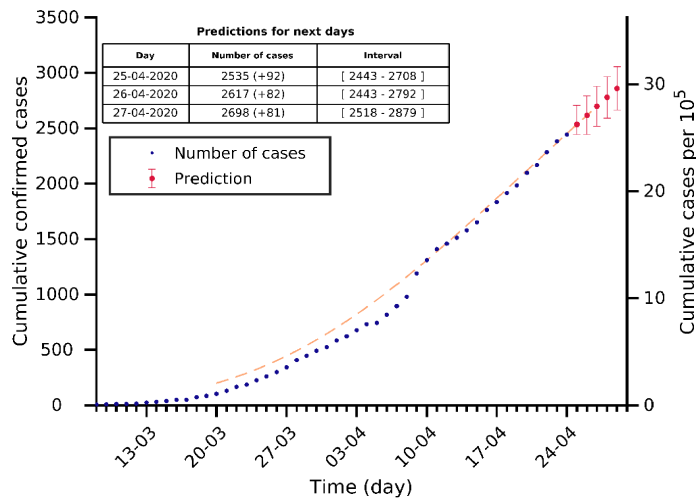


# Greece 24-04-2020. Population: 10.4M. Current cumulated incidence: 24/10<sup>5</sup>

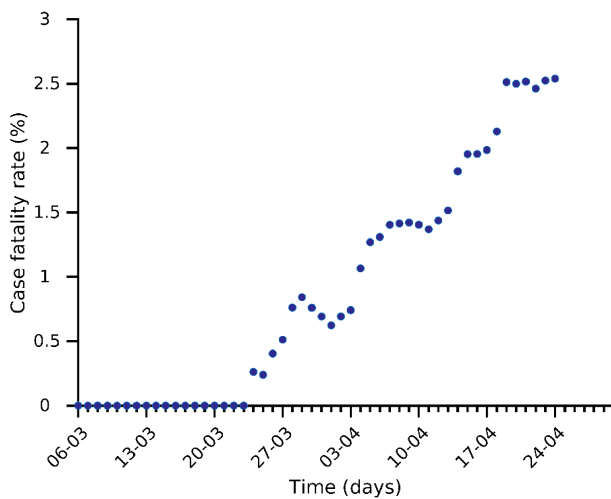
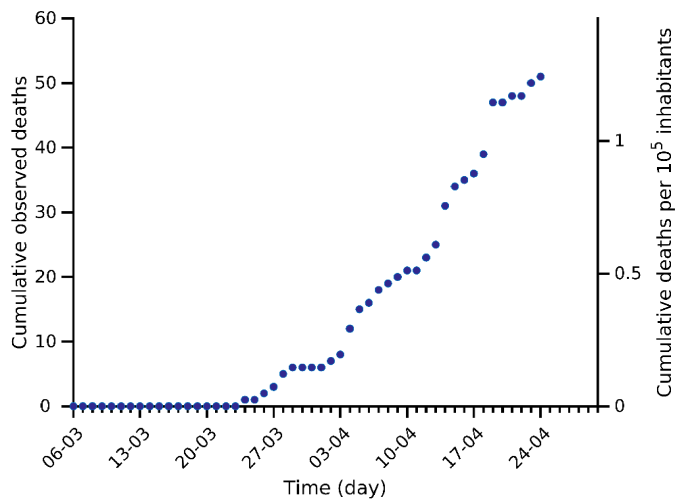
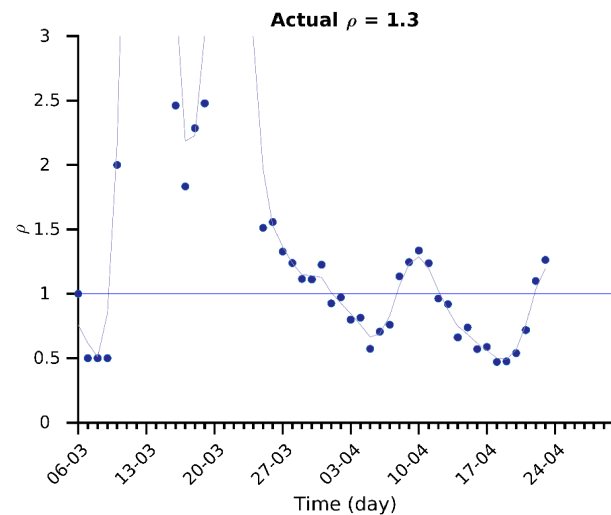
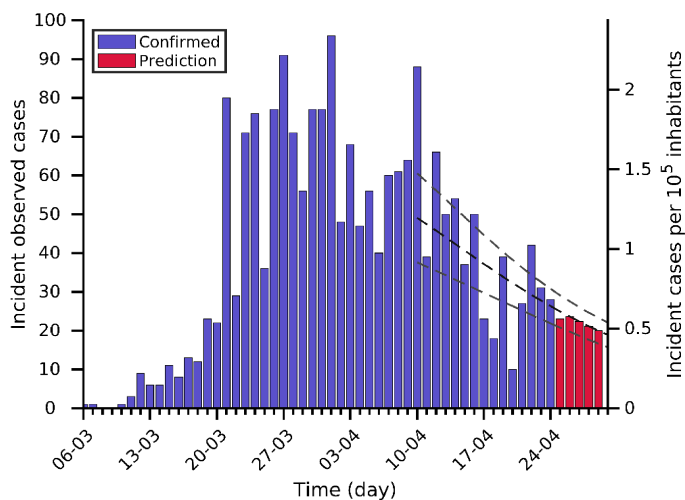
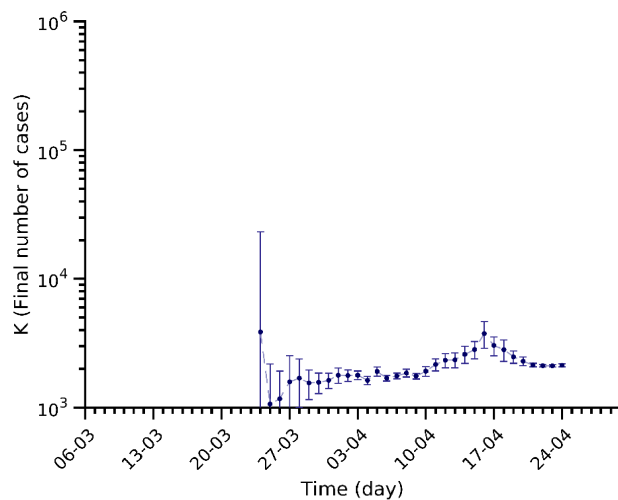
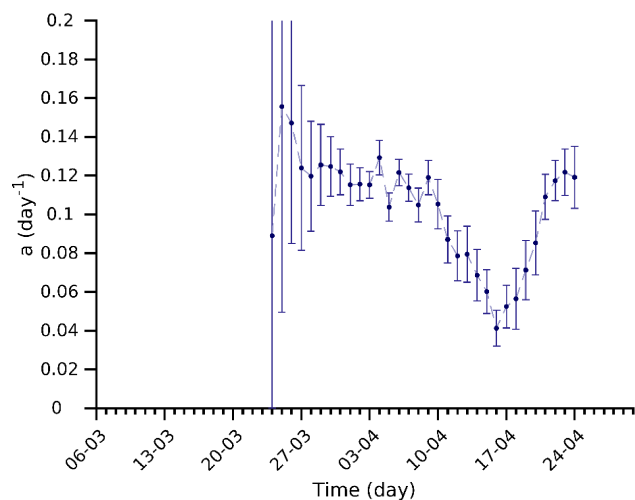
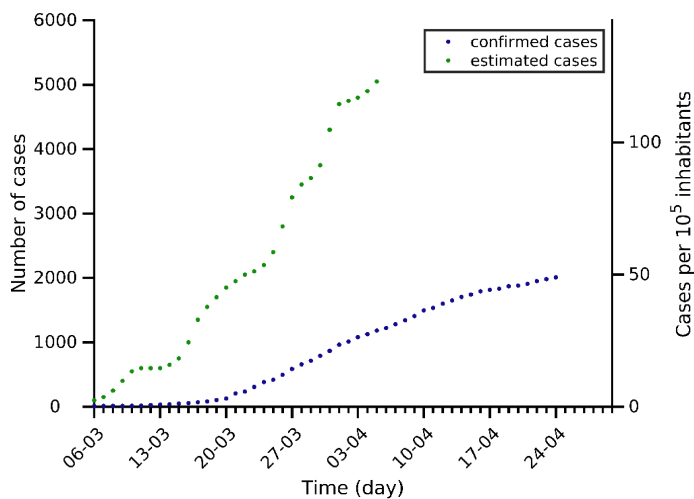
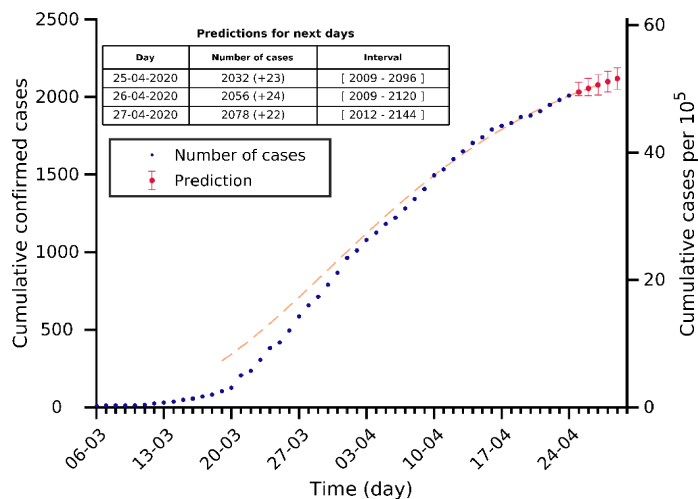




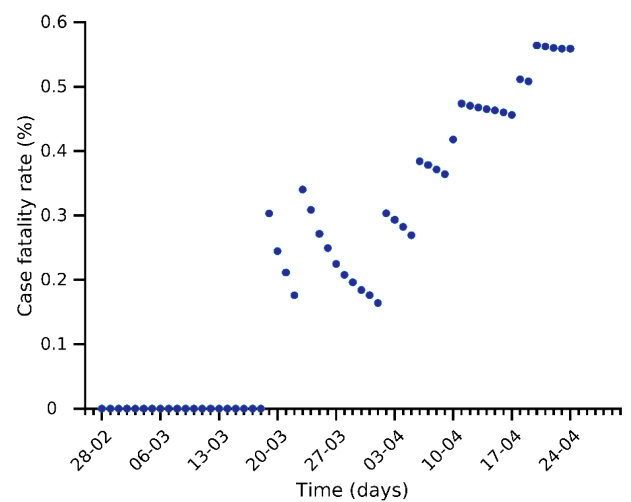
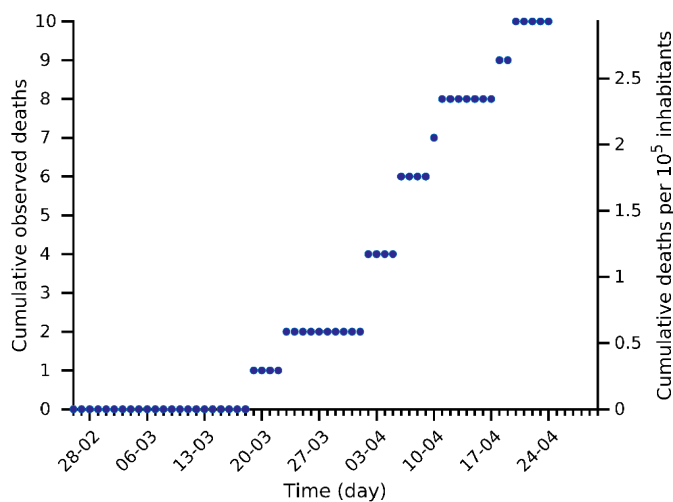
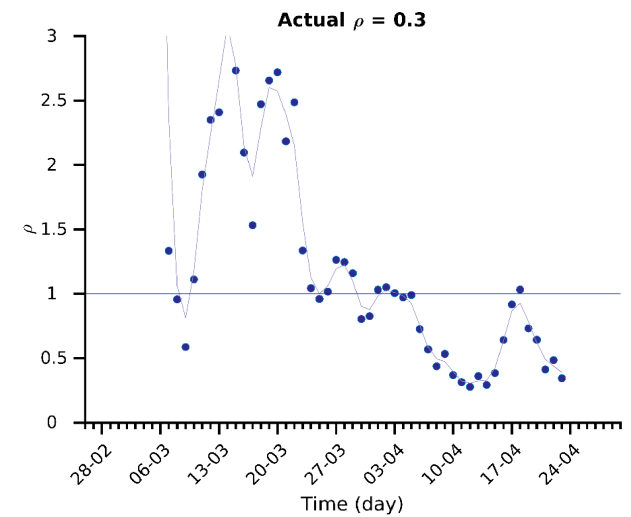
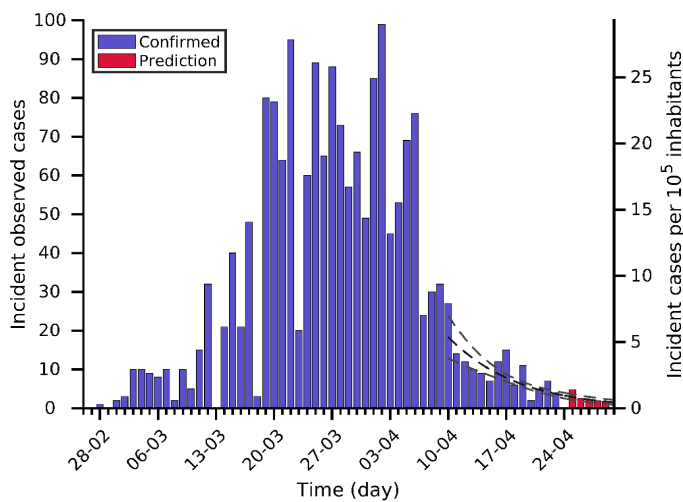
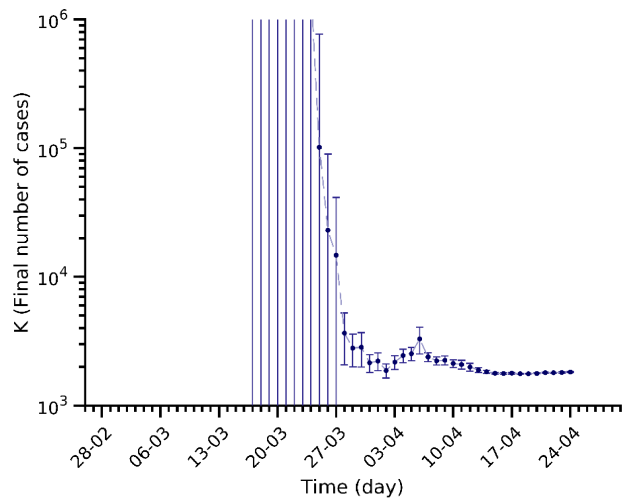
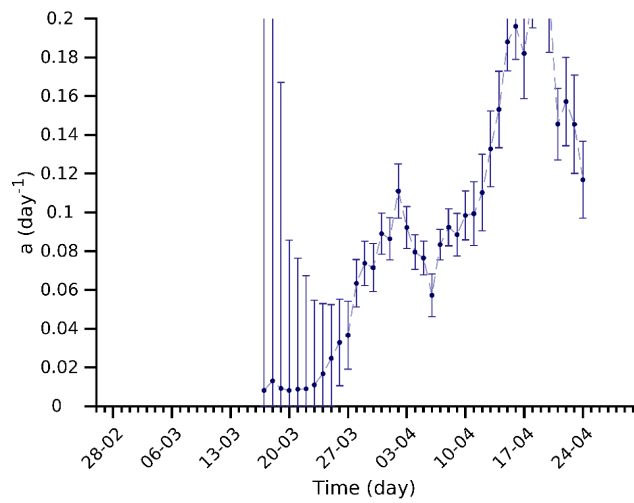
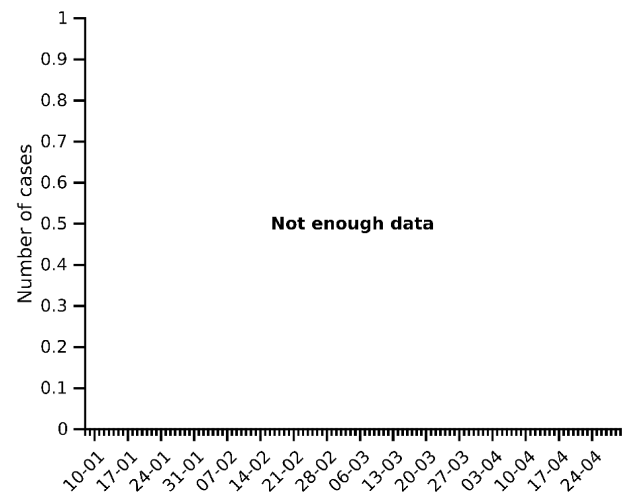
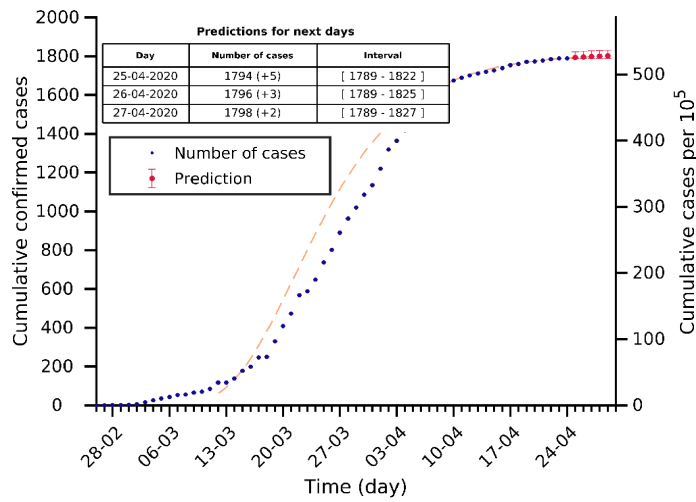
# Hungary 24-04-2020. Population: 9.7M. Current cumulated incidence: $25/10^5$



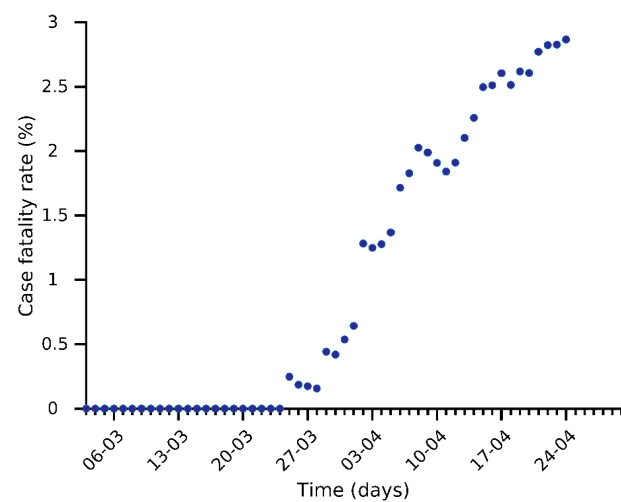
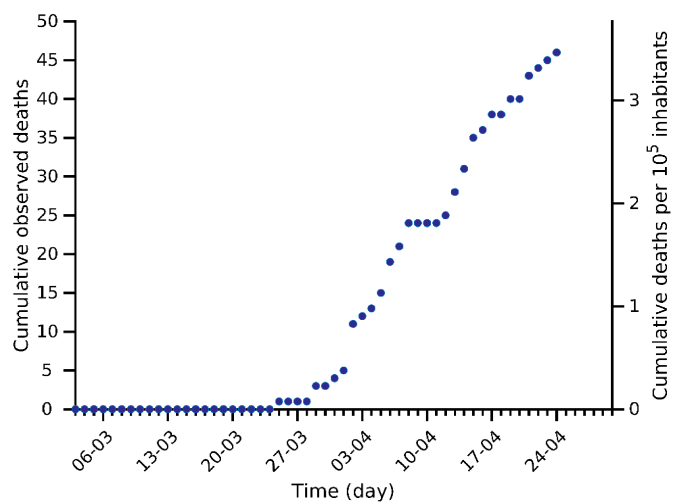
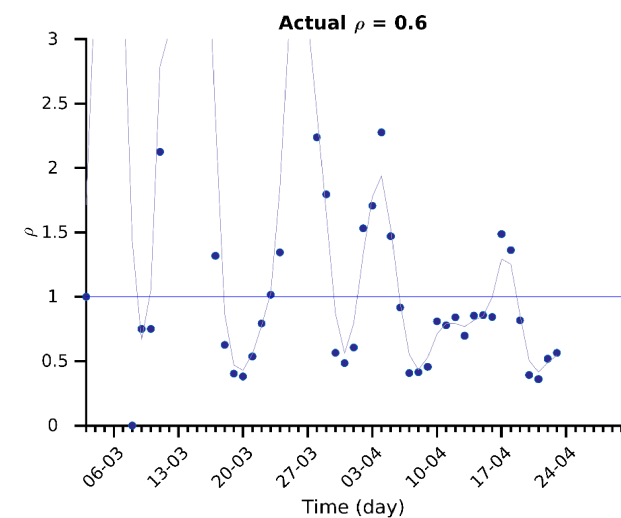
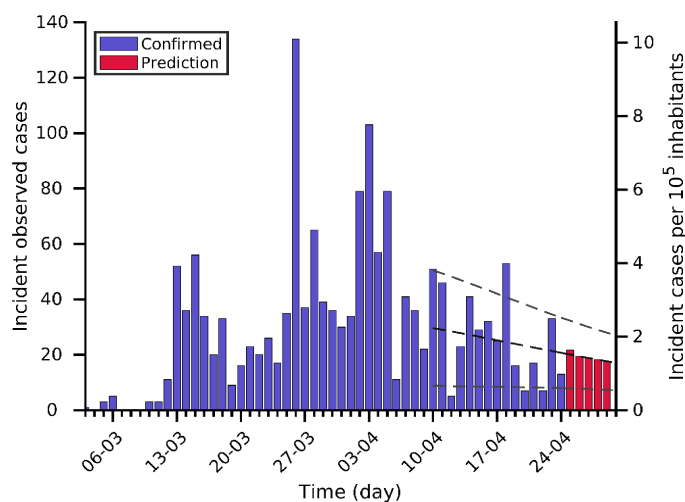
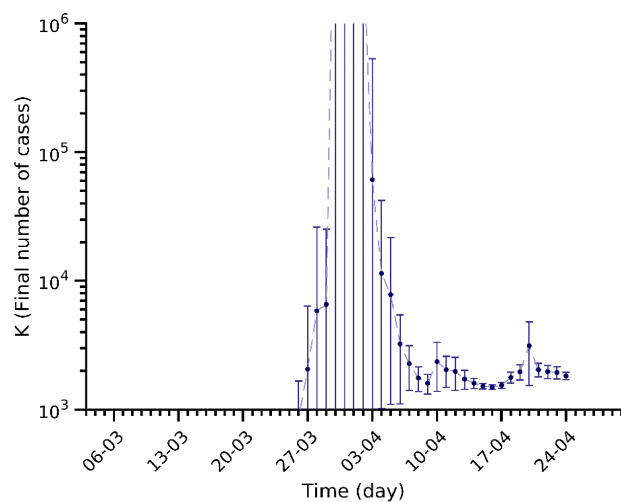
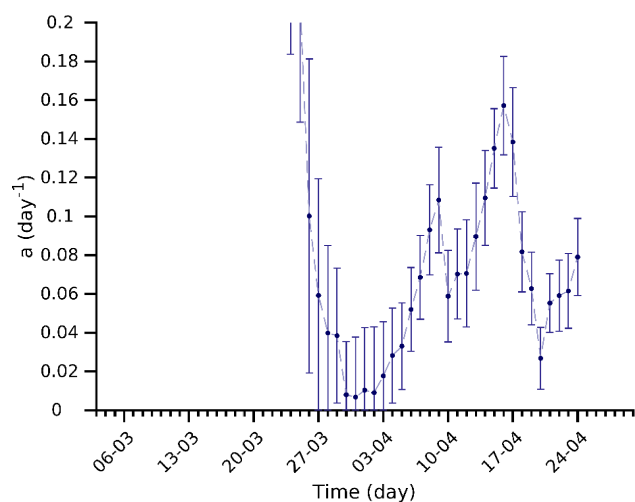
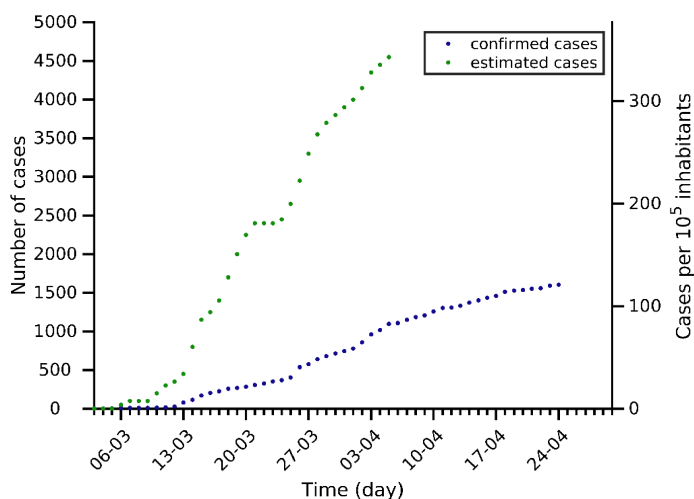
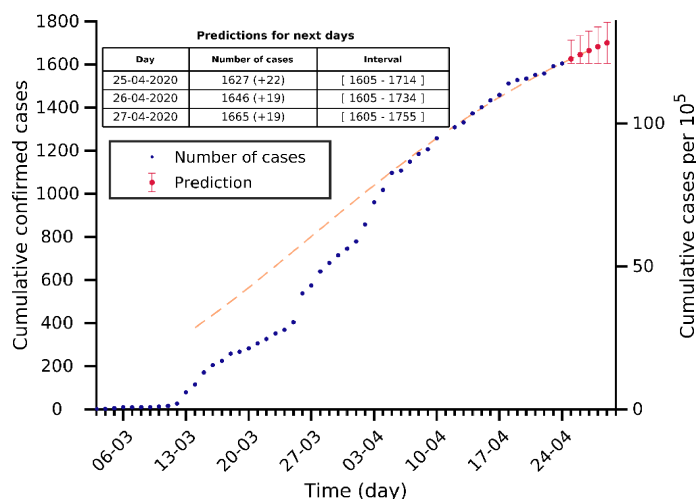
# Croatia 24-04-2020. Population: 4.1M. Current cumulated incidence: 49/10<sup>5</sup>



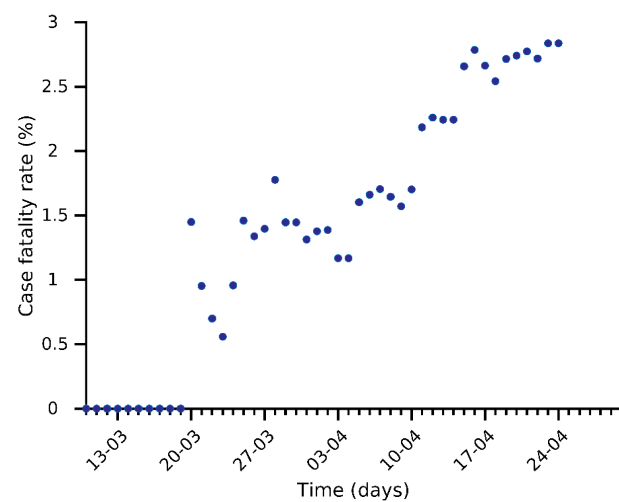
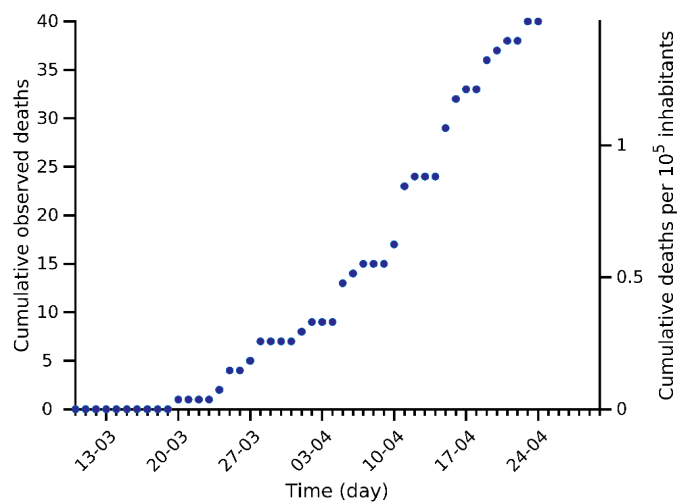
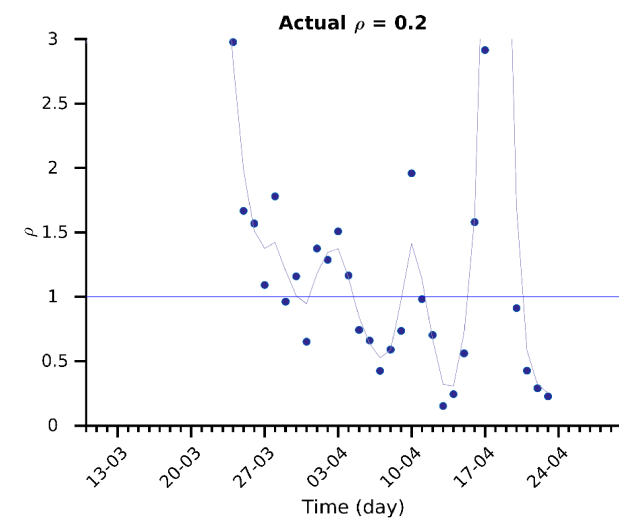
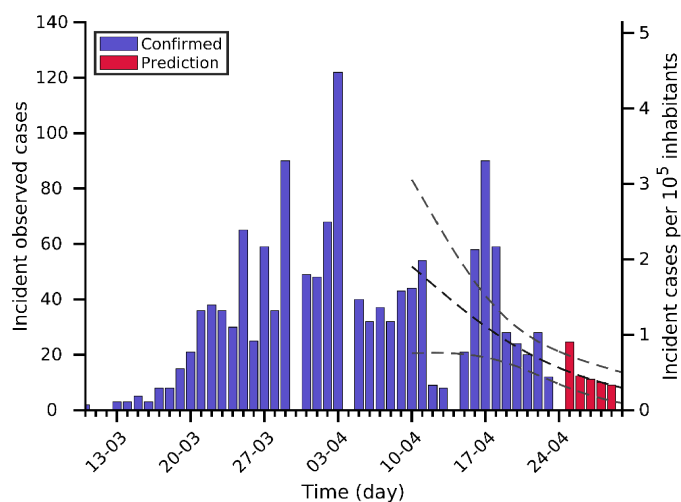
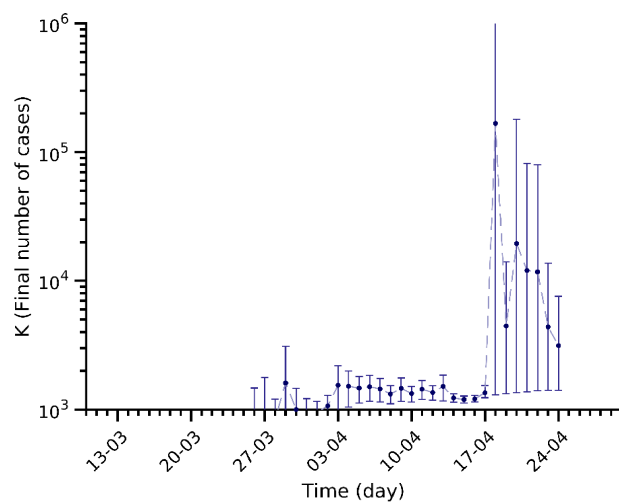
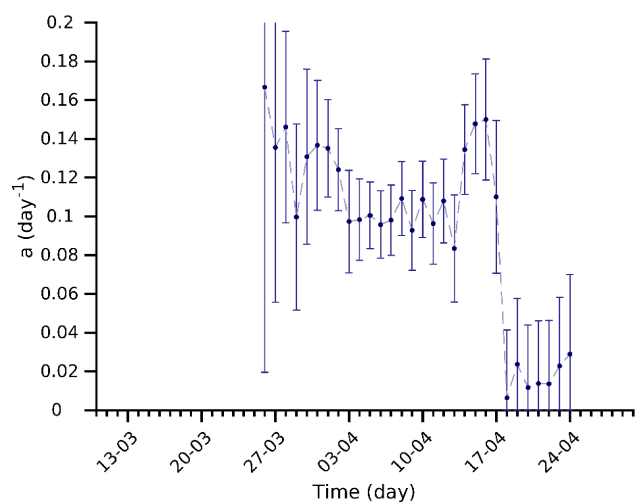
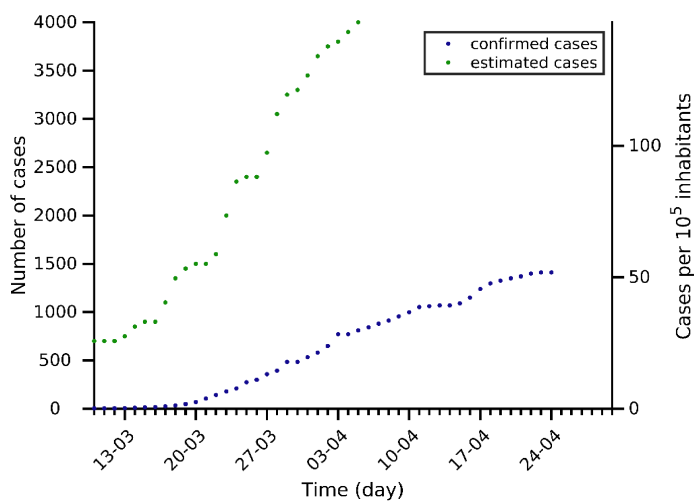
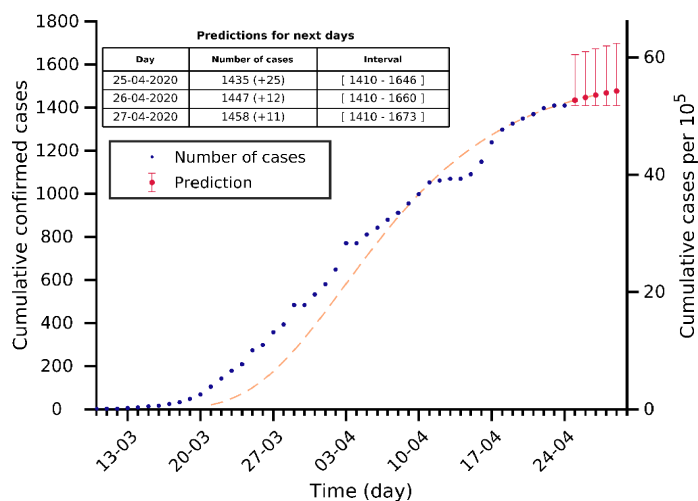
# Iceland 24-04-2020. Population: 0.3M. Current cumulated incidence: 524/10<sup>5</sup>



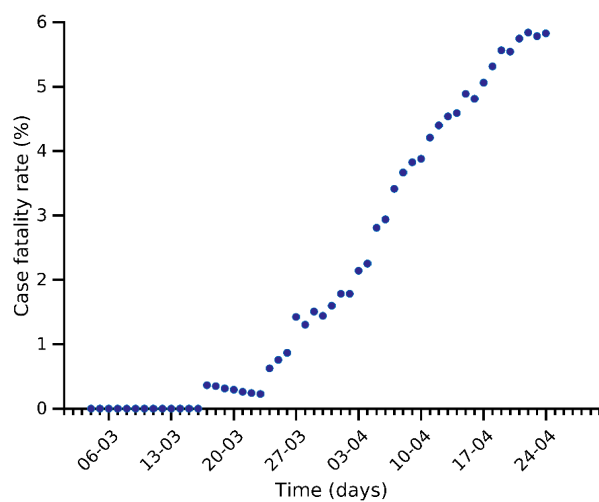
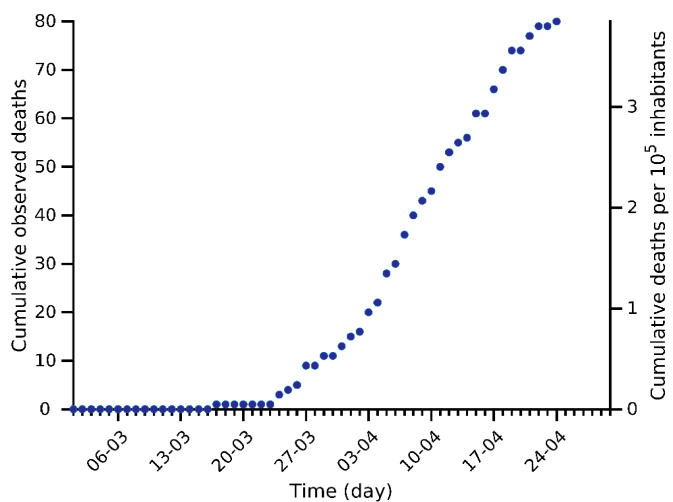
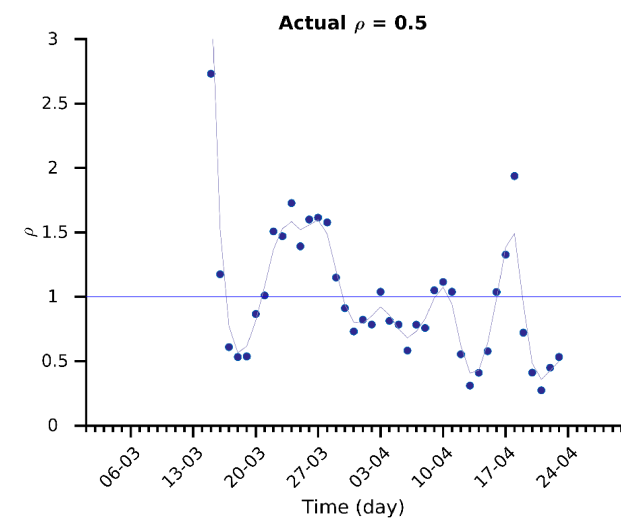
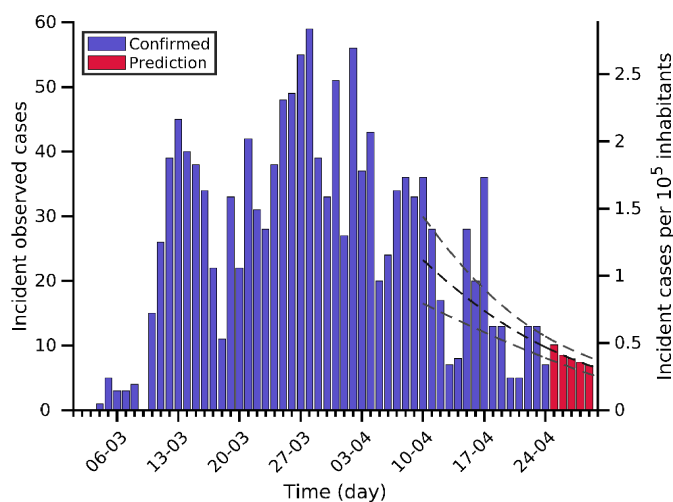
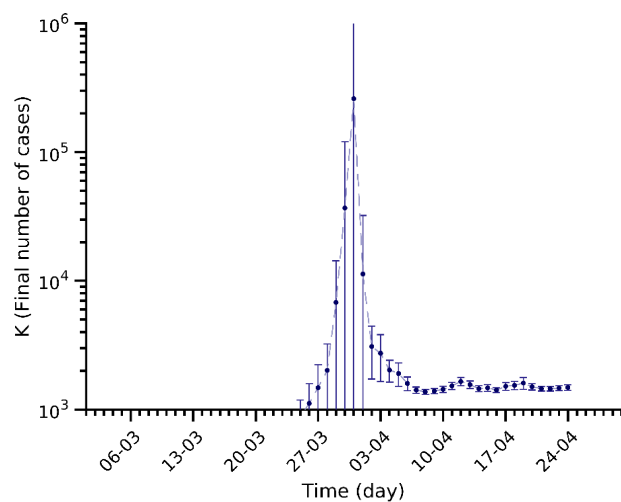
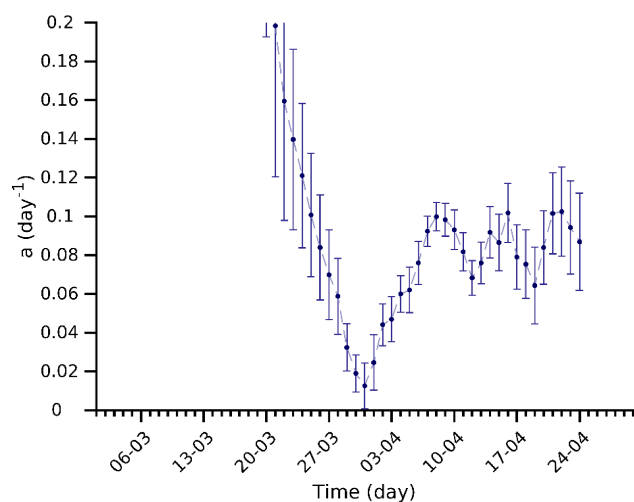
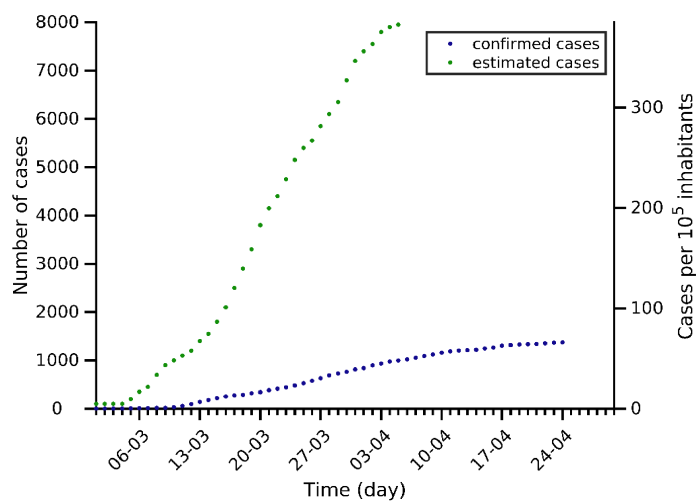
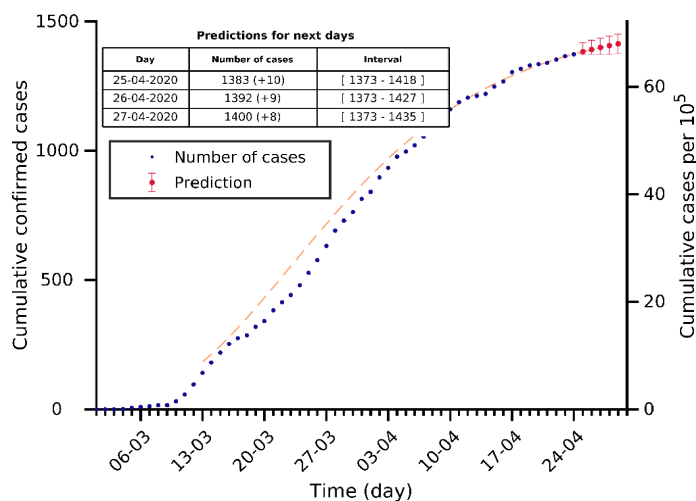
# Estonia 24-04-2020. Population: 1.3M. Current cumulated incidence: 121/10<sup>5</sup>



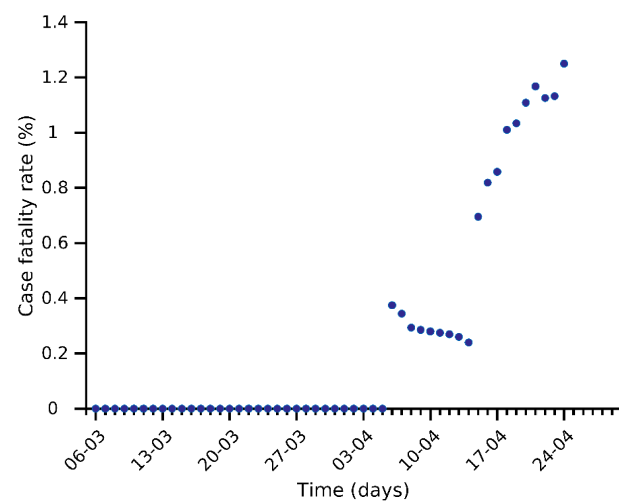
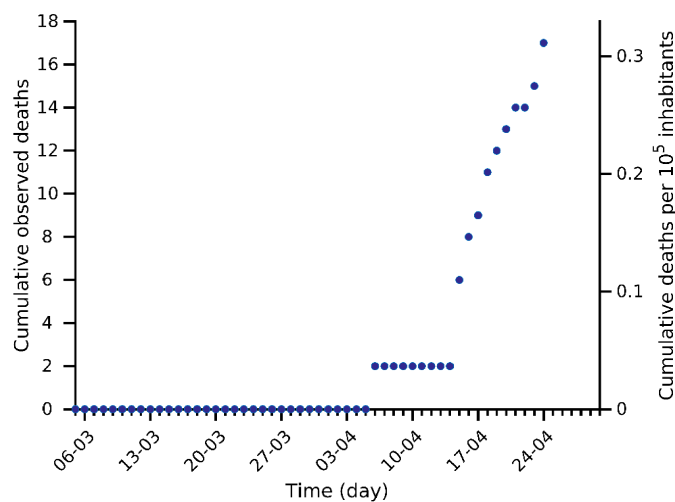
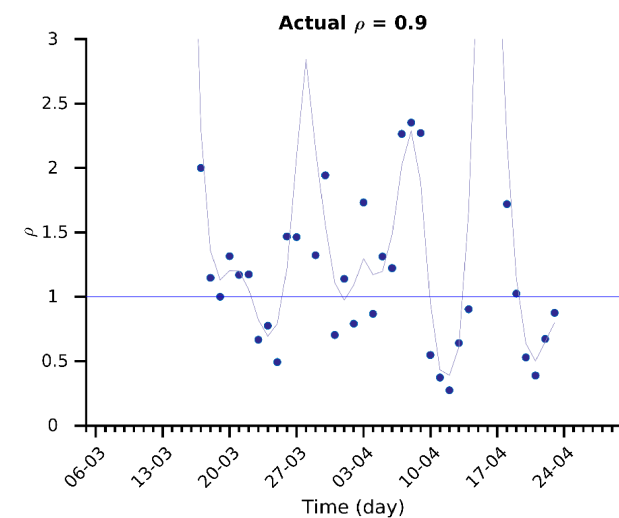
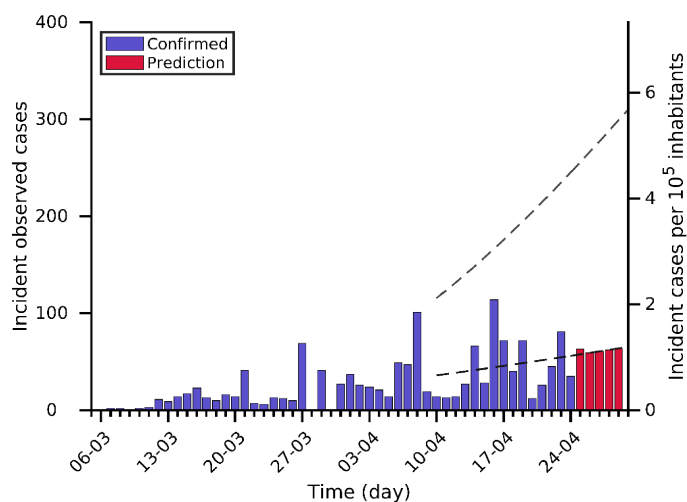
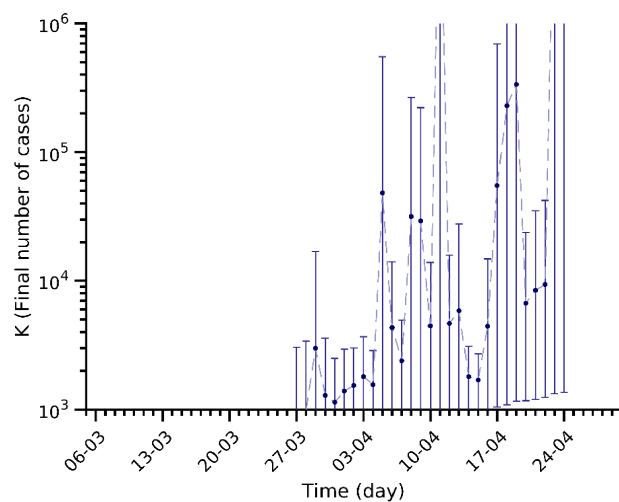
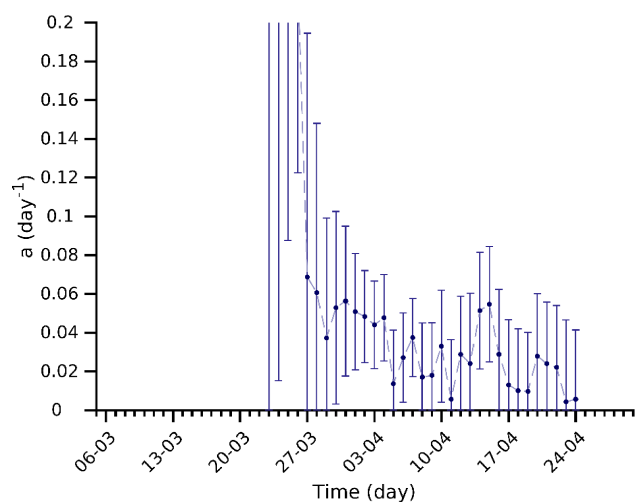
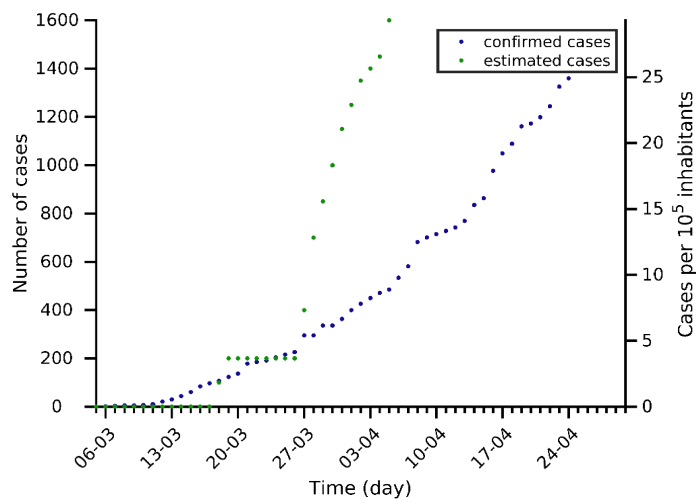
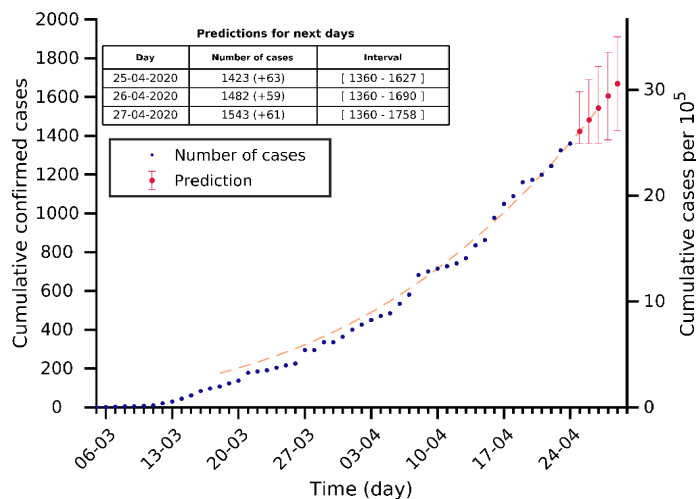
# Lithuania 24-04-2020. Population: 2.7M. Current cumulated incidence: 52/10<sup>5</sup>



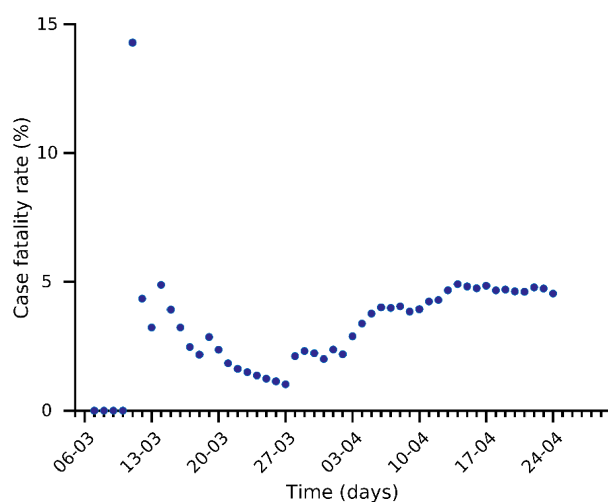
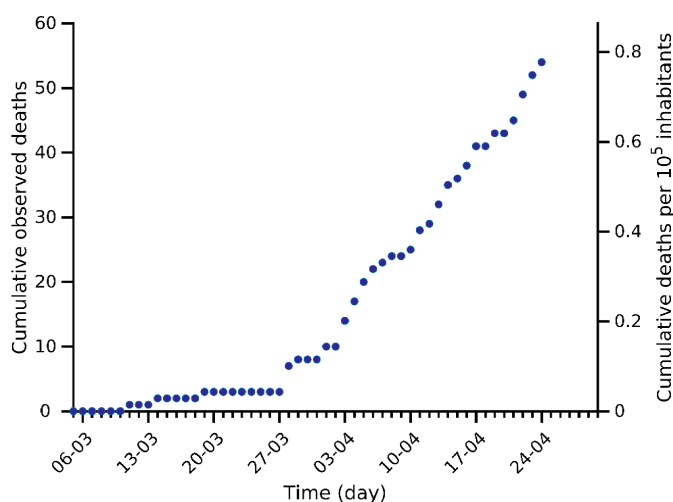
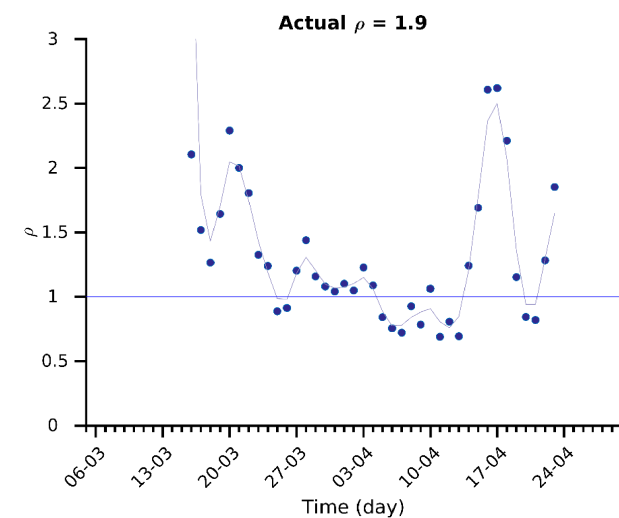
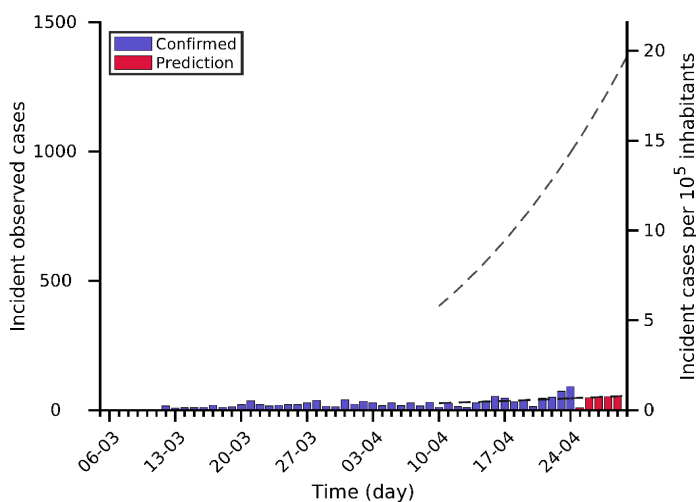
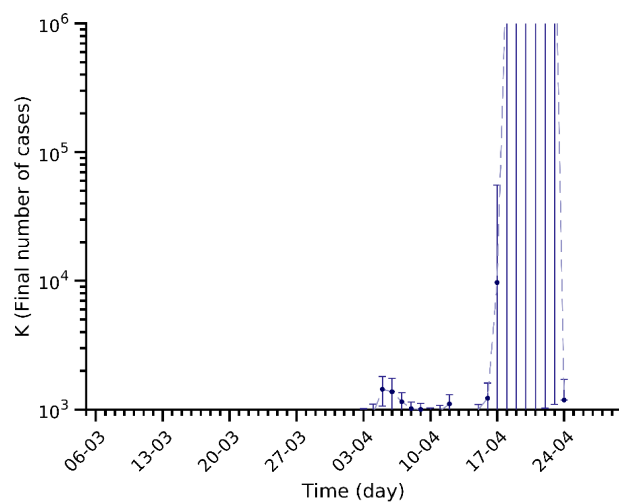
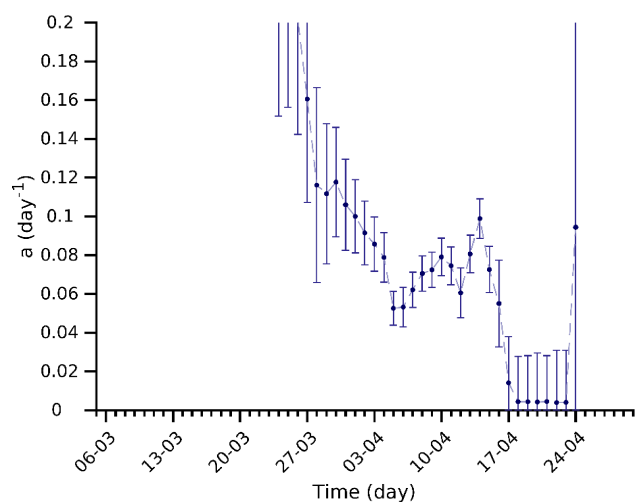
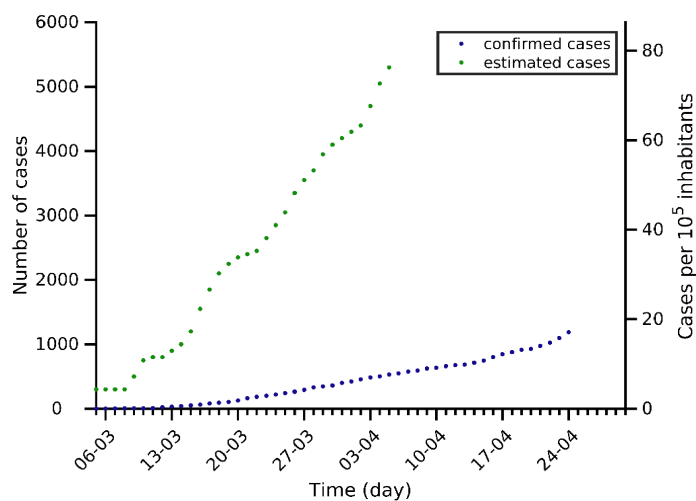
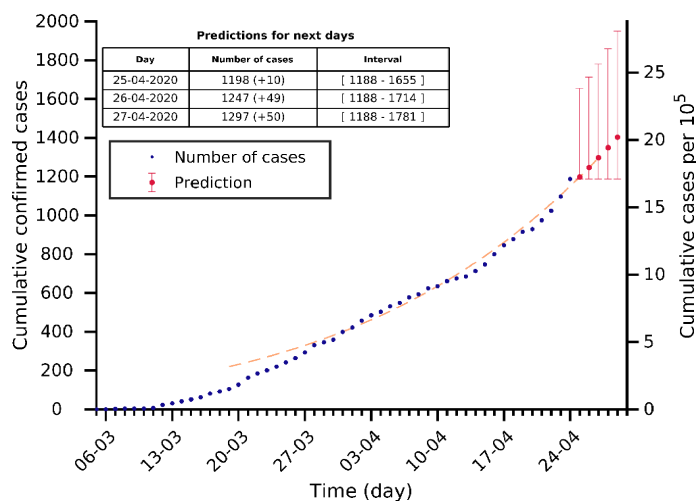
# Slovenia 24-04-2020. Population: 2.1M. Current cumulated incidence: 66/10<sup>5</sup>



# Slovakia 24-04-2020. Population: 5.5M. Current cumulated incidence: 25/10<sup>5</sup>

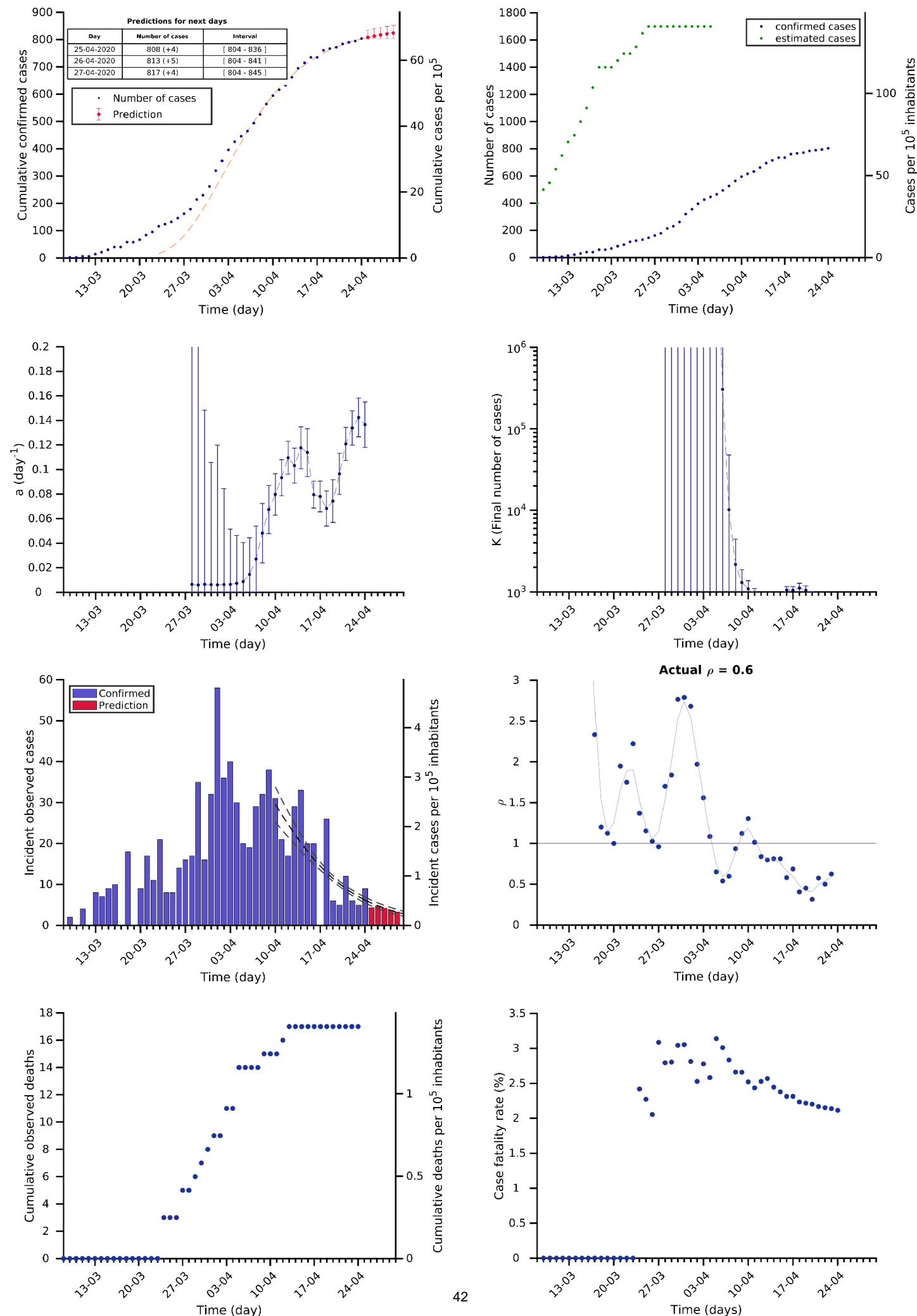


# Bulgaria 24-04-2020. Population: 6.9M. Current cumulated incidence: 17/10<sup>5</sup>

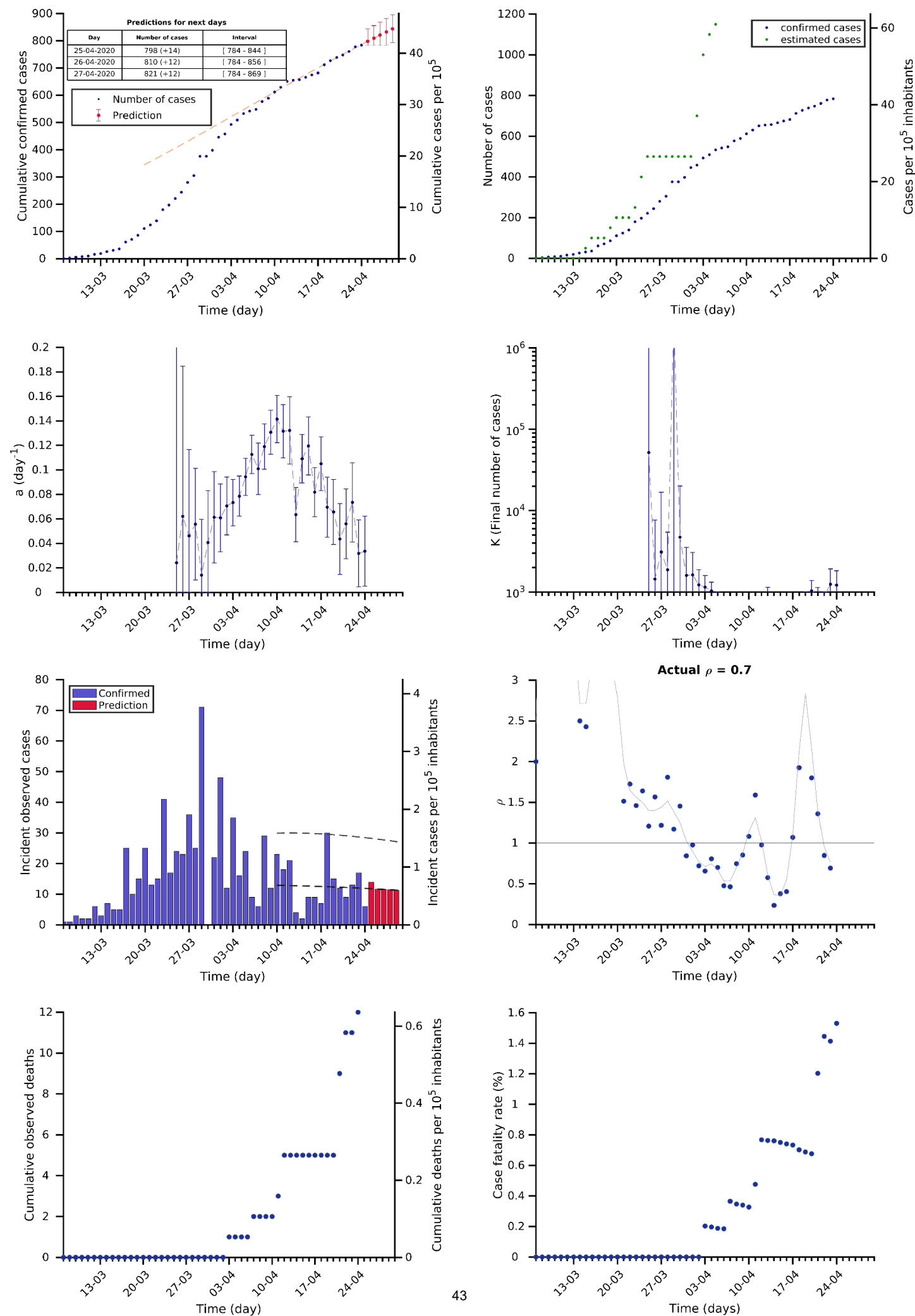




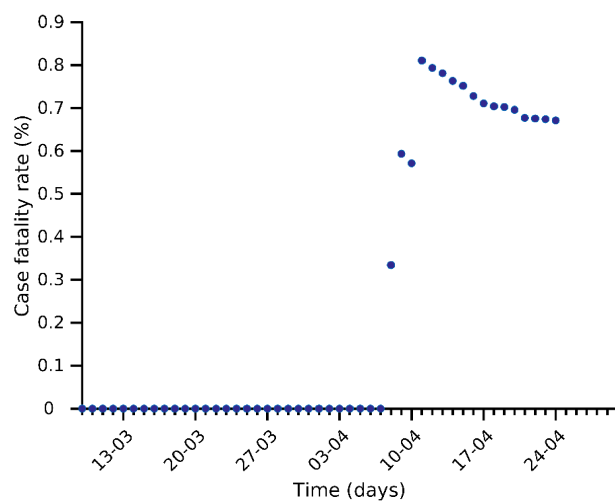
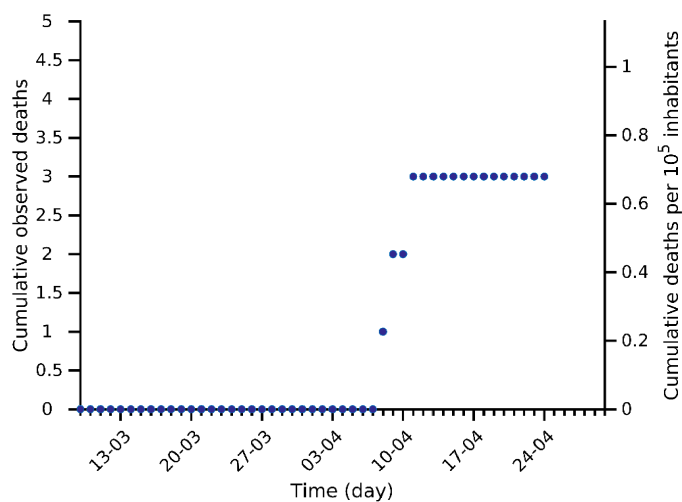
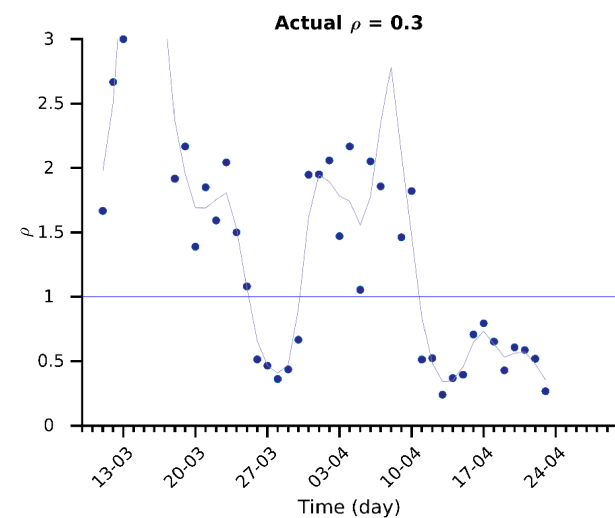
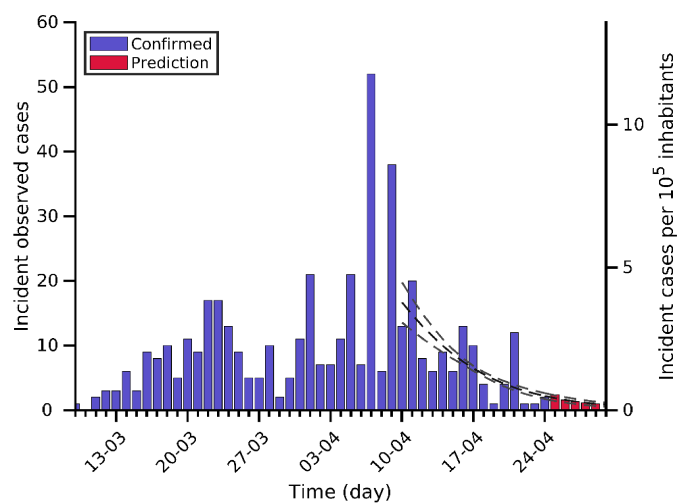
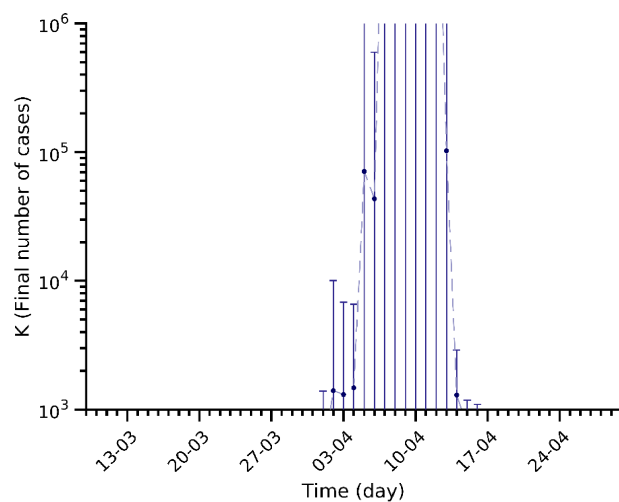
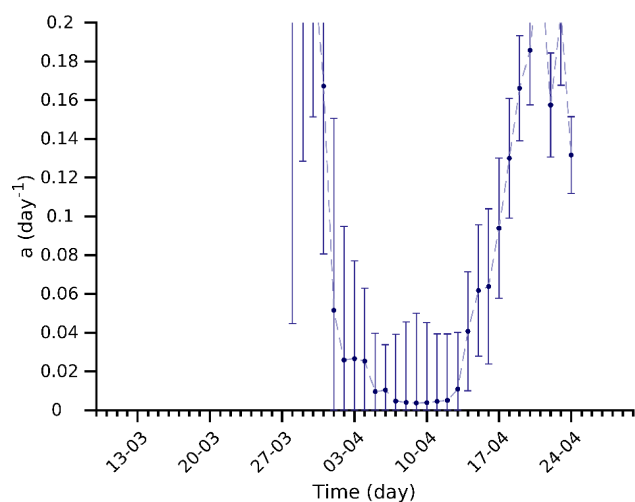
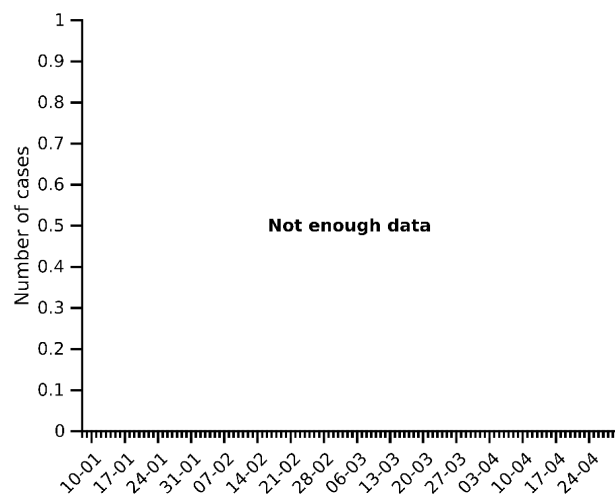
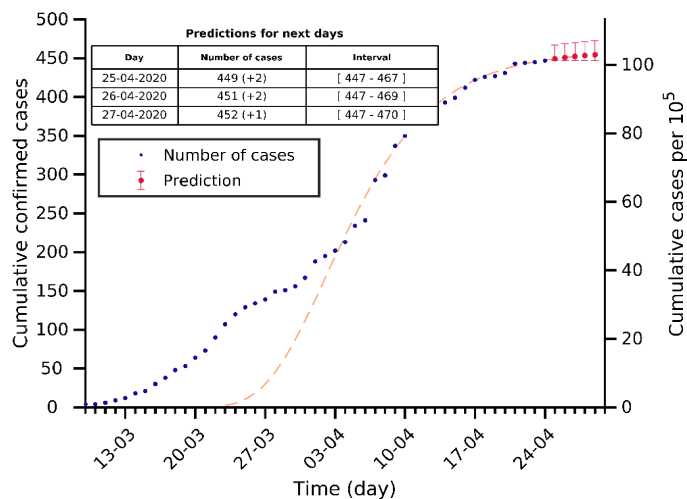
# Cyprus 24-04-2020. Population: 1.2M. Current cumulated incidence: 67/10<sup>5</sup>



# Latvia 24-04-2020. Population: 1.9M. Current cumulated incidence: 42/10<sup>5</sup>



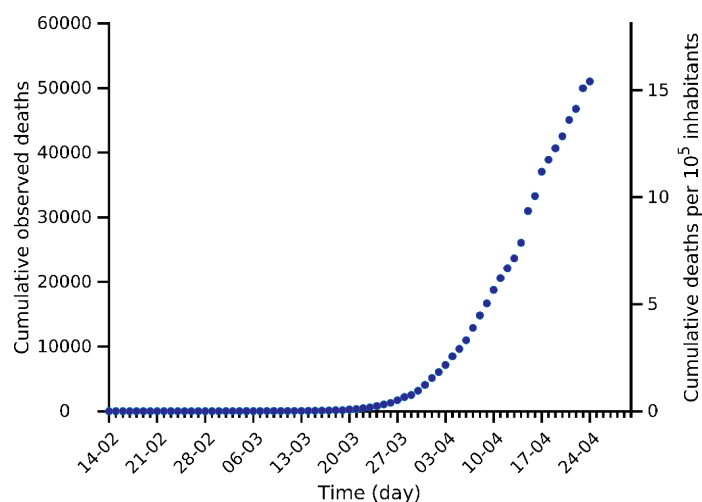
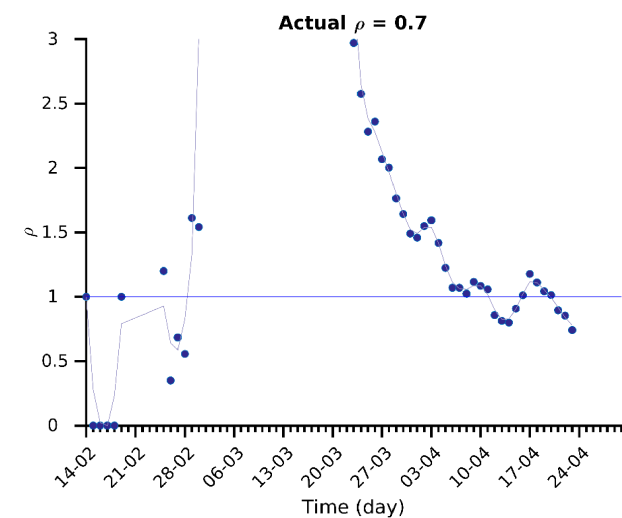
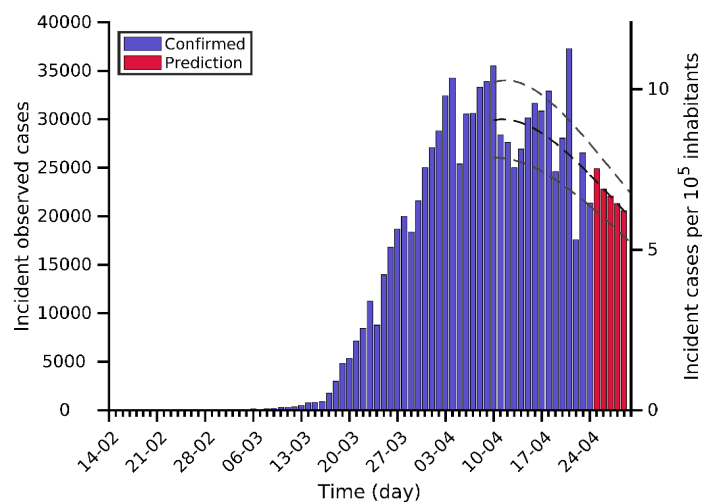
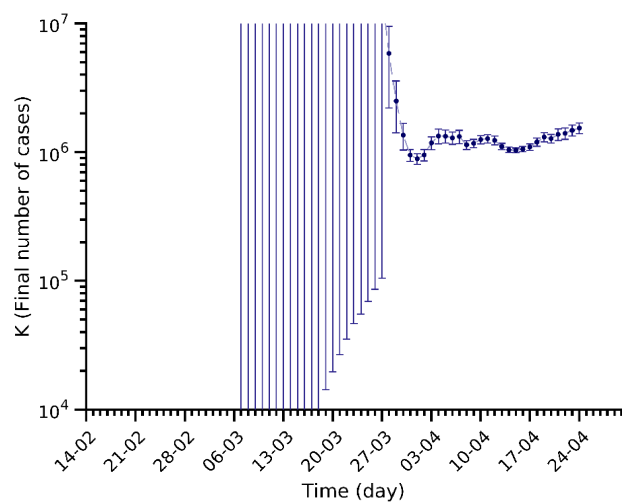
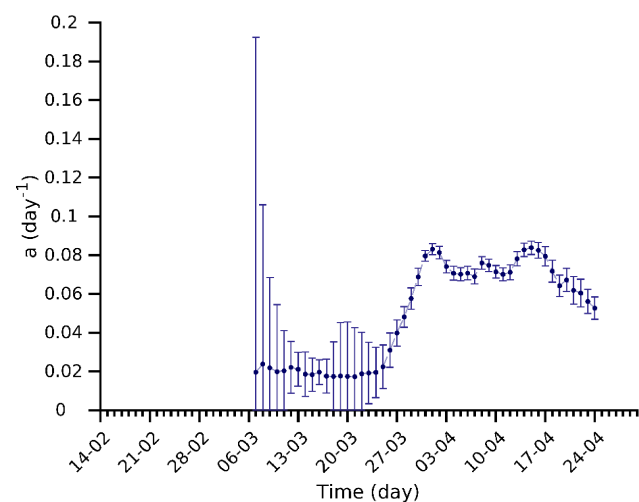
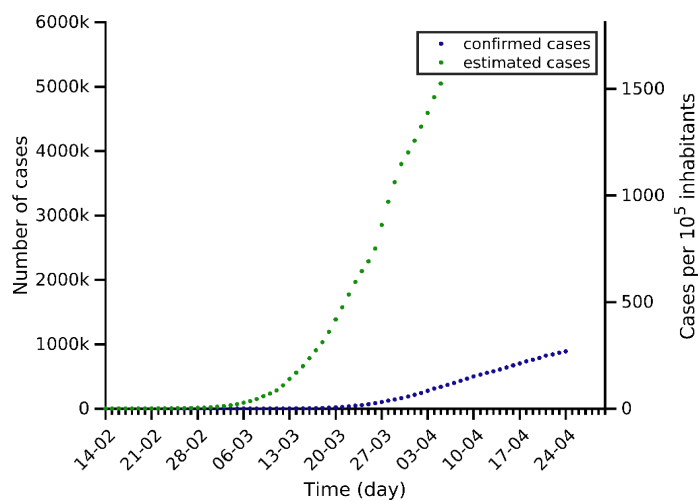
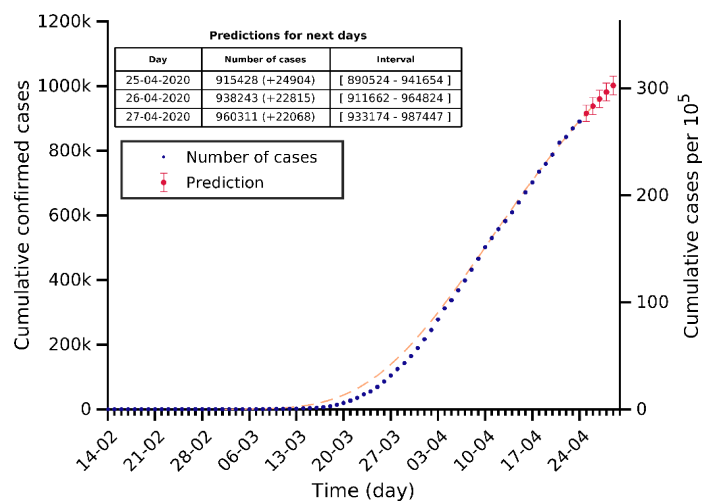
# Malta 24-04-2020. Population: 0.4M. Current cumulated incidence: 101/10<sup>5</sup>



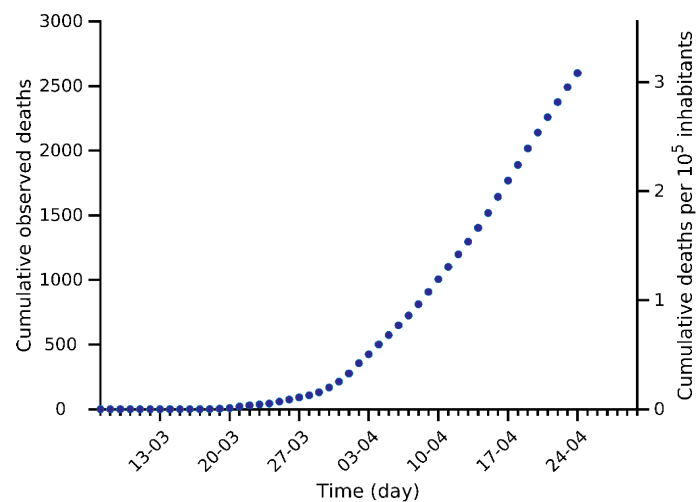
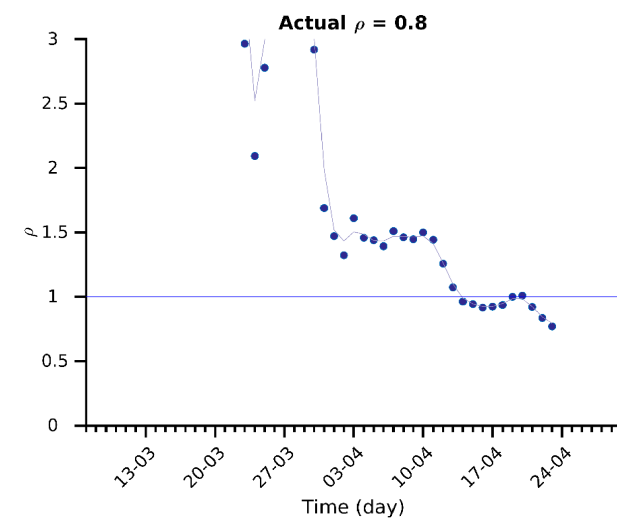
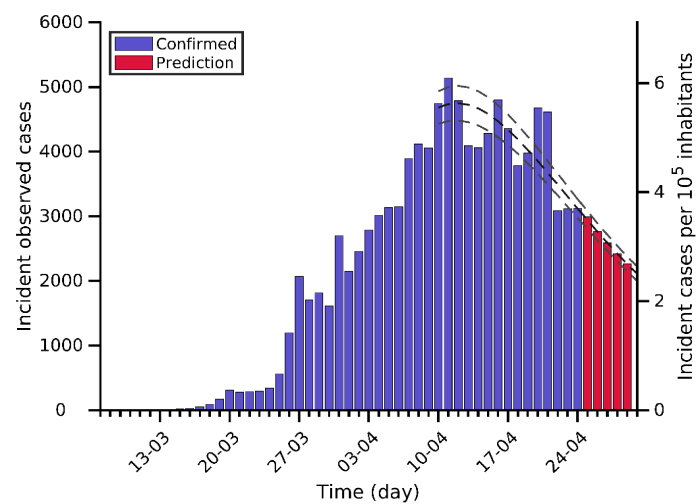
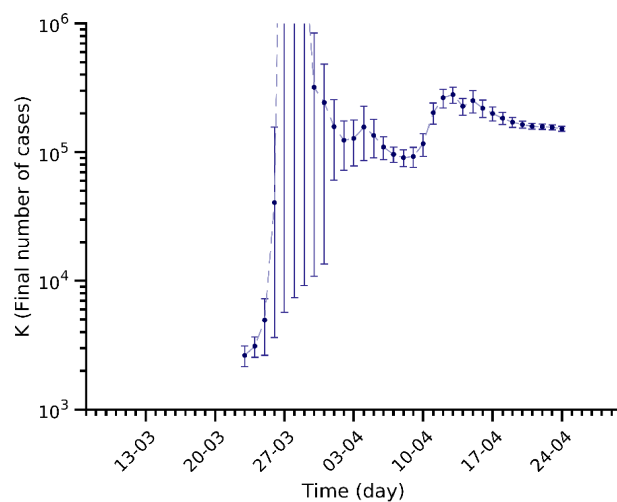
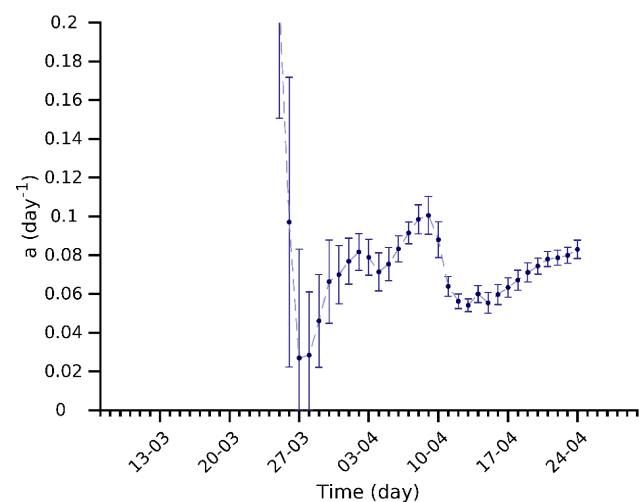
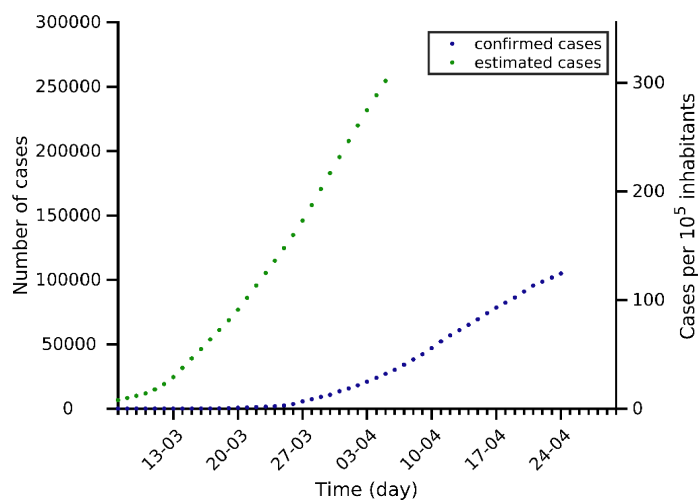
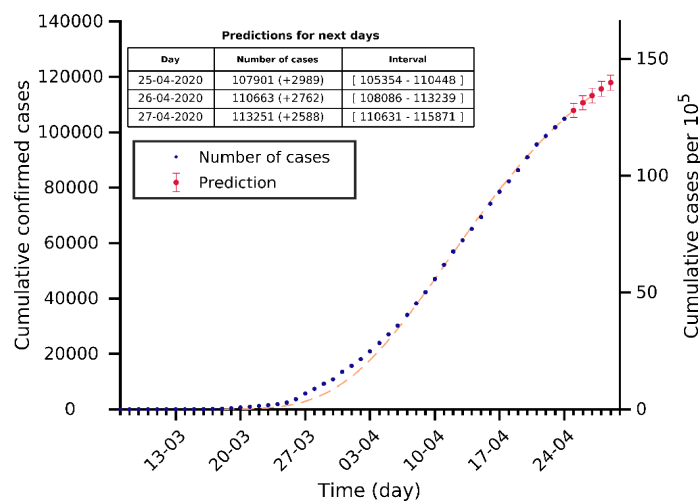
## **(2) Analysis and prediction of COVID-19 for other countries**

Data obtained from <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>

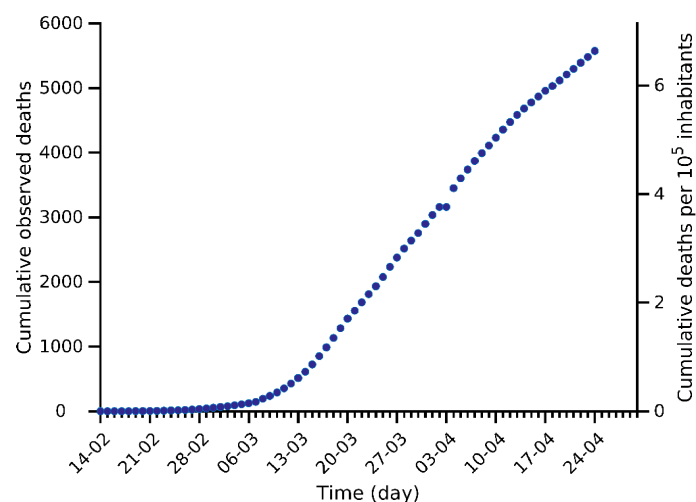
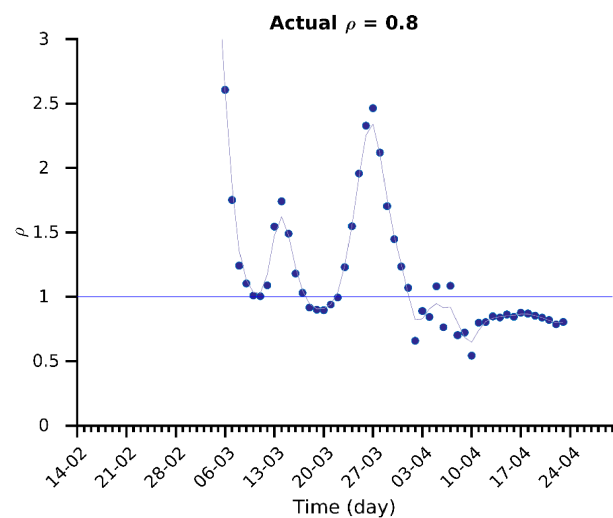
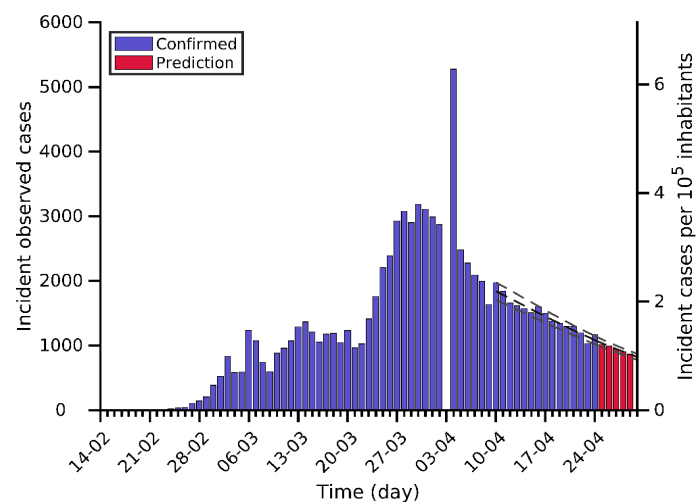
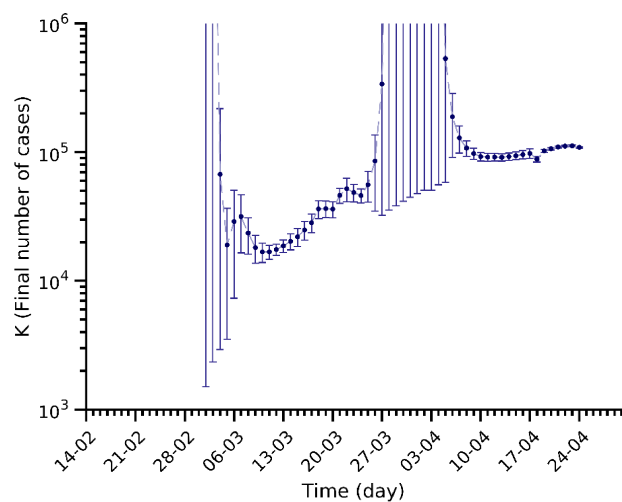
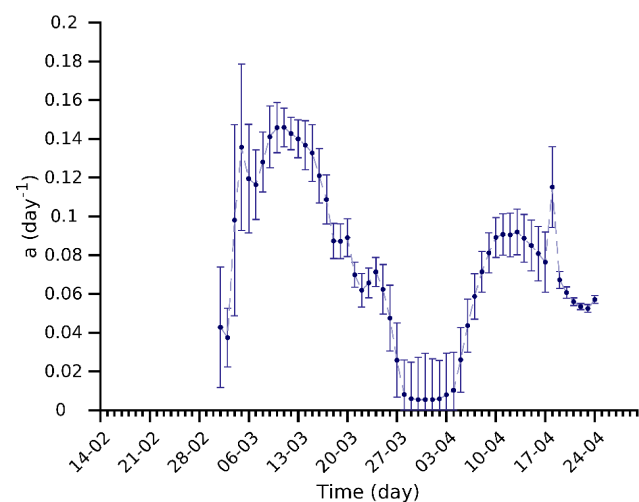
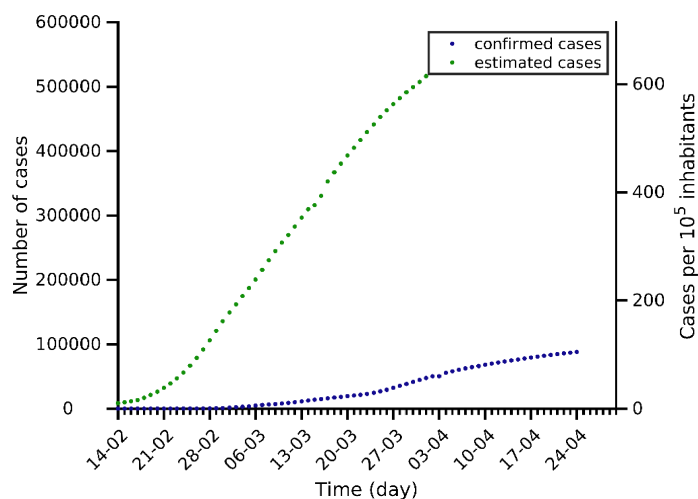
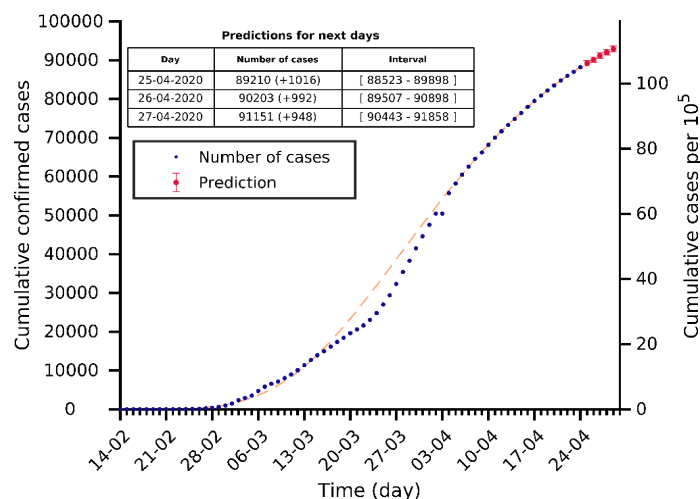
# USA 24-04-2020. Population: 331.0M. Current cumulated incidence: 269/10<sup>5</sup>



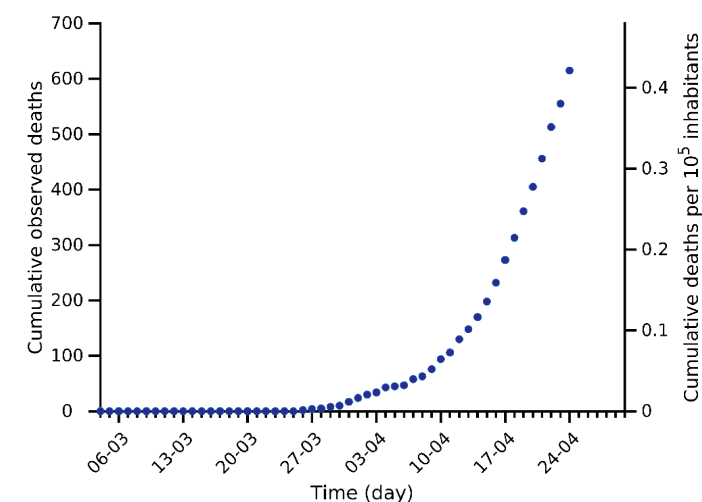
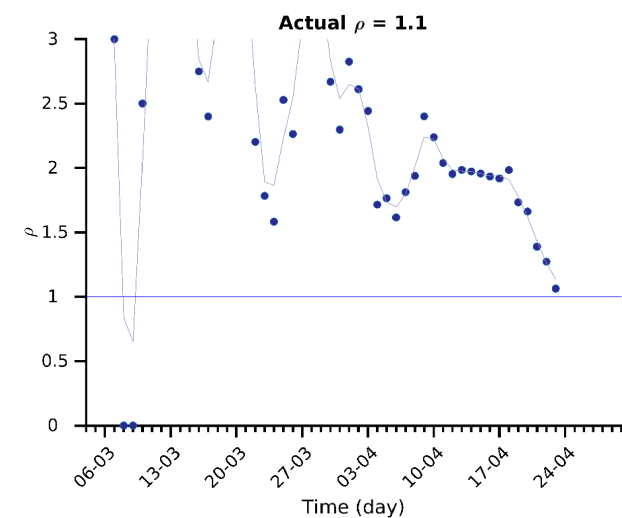
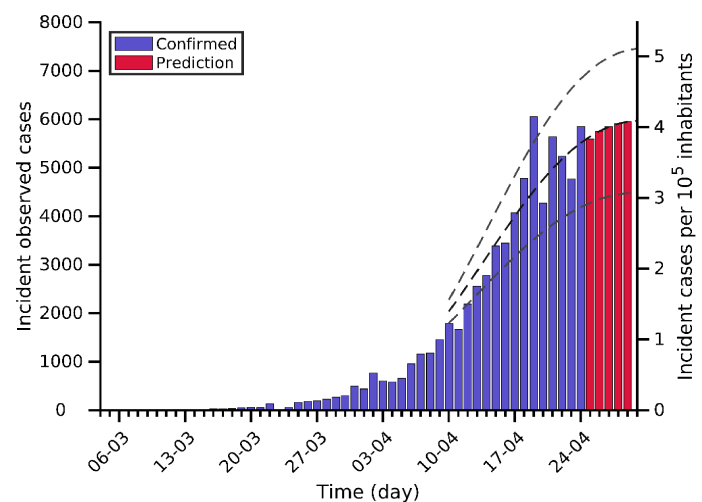
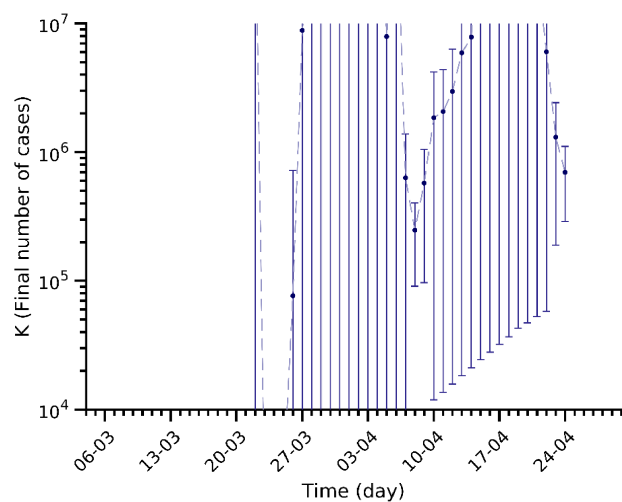
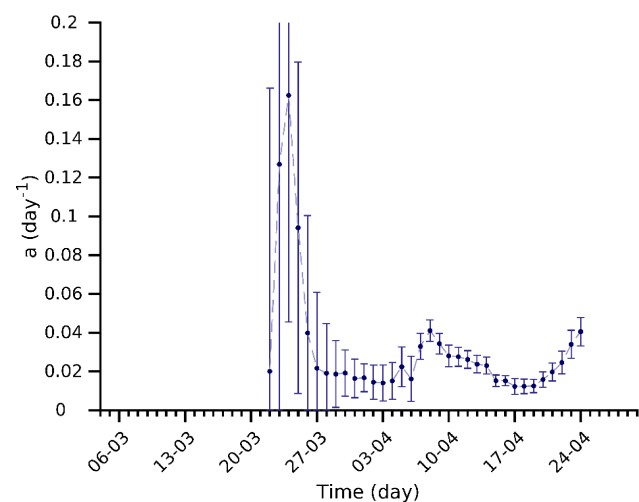
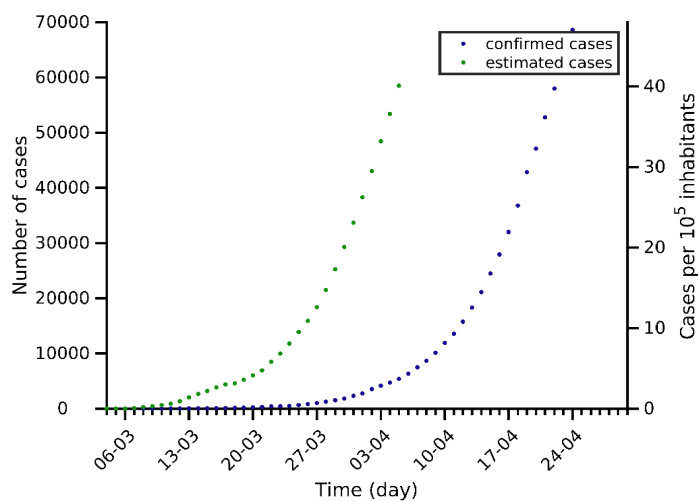
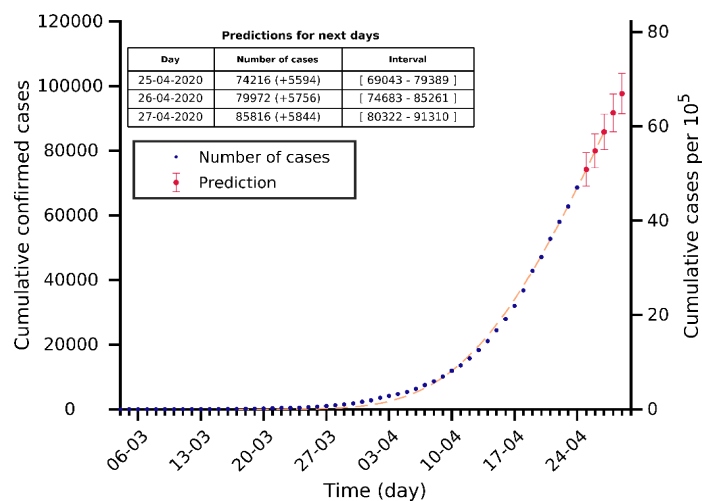
# Turkey 24-04-2020. Population: 84.3M. Current cumulated incidence: 124/10<sup>5</sup>



# Iran 24-04-2020. Population: 84.0M. Current cumulated incidence: 105/10<sup>5</sup>

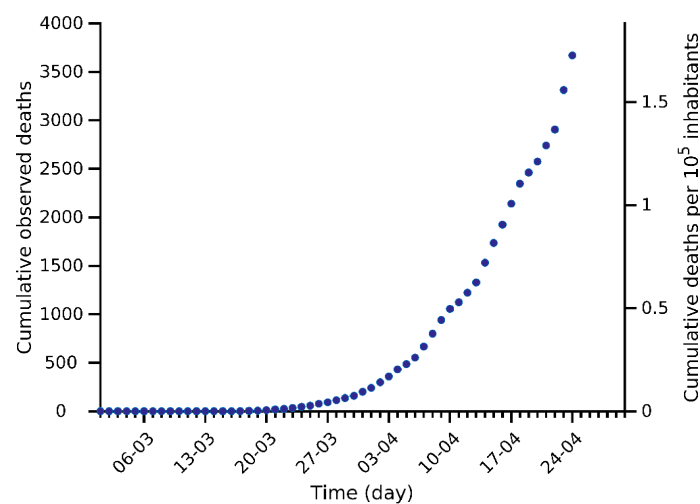
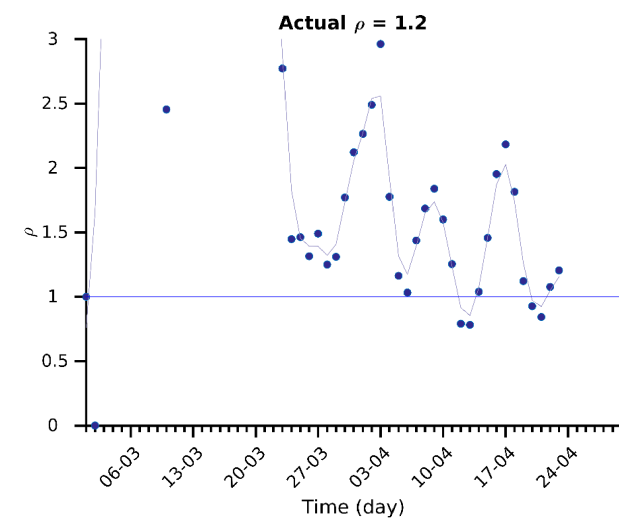
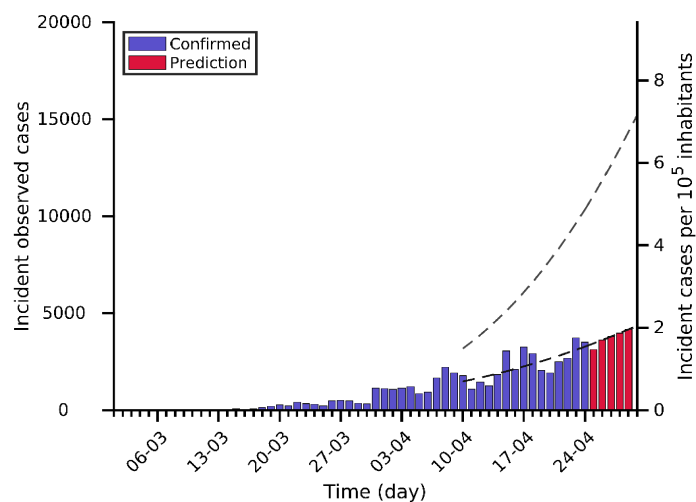
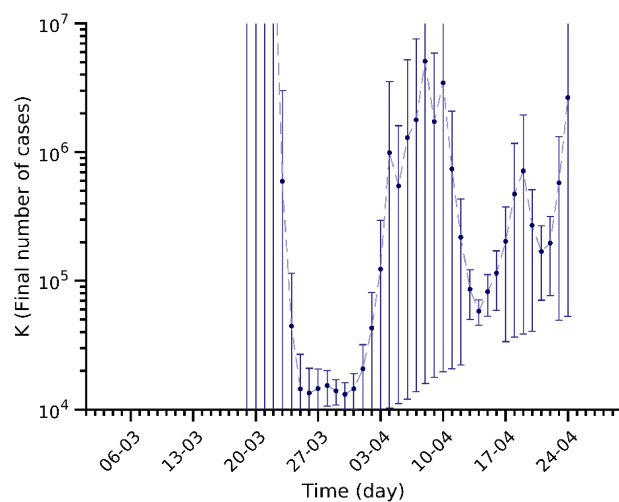
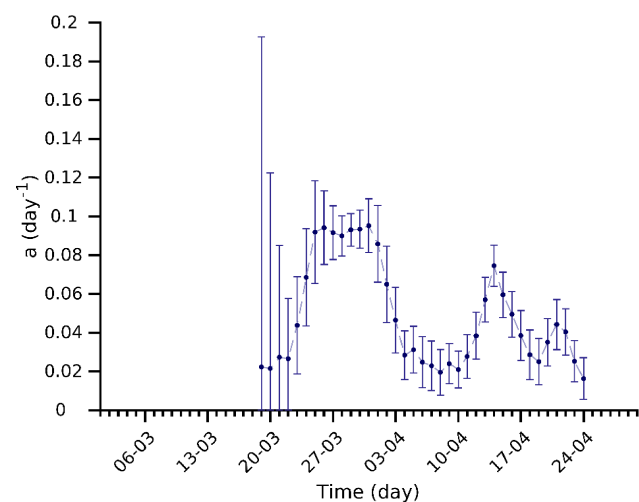
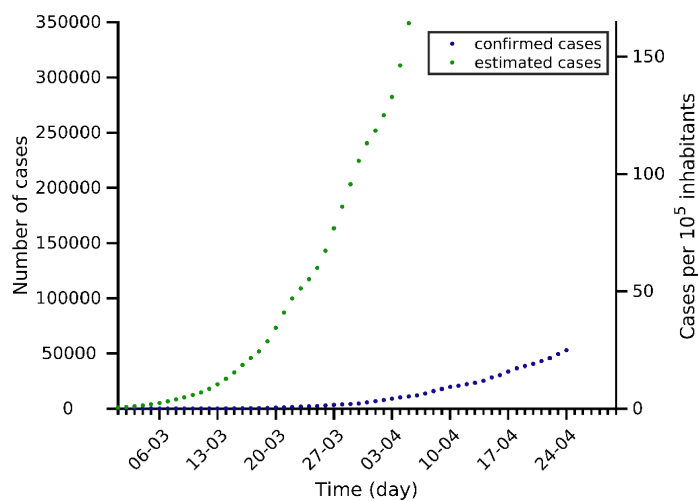
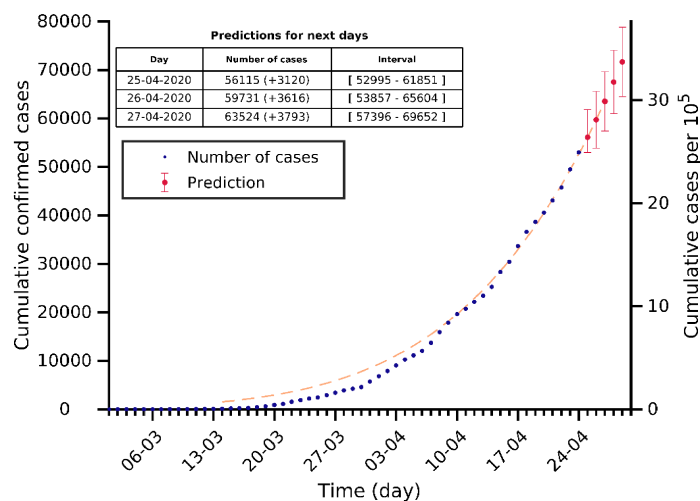


# Russia 24-04-2020. Population: 145.9M. Current cumulated incidence: 47/10<sup>5</sup>

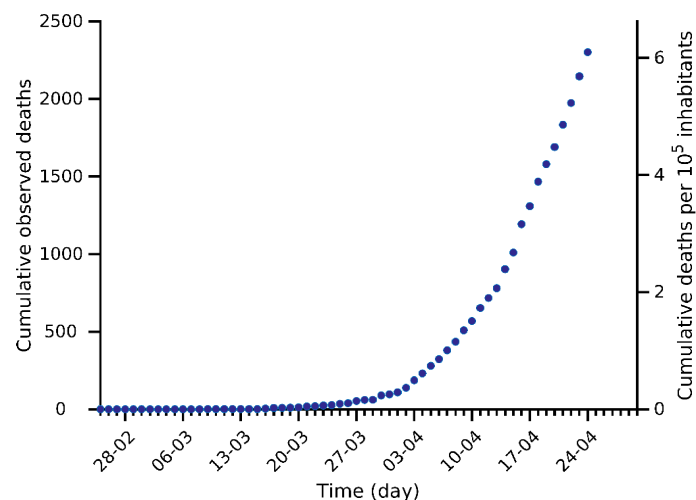
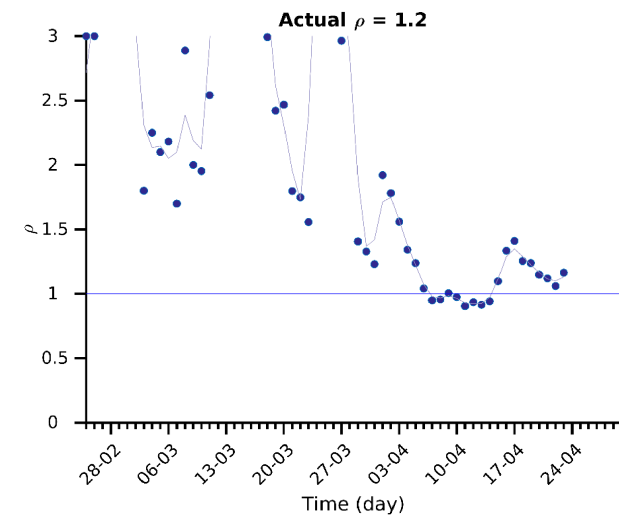
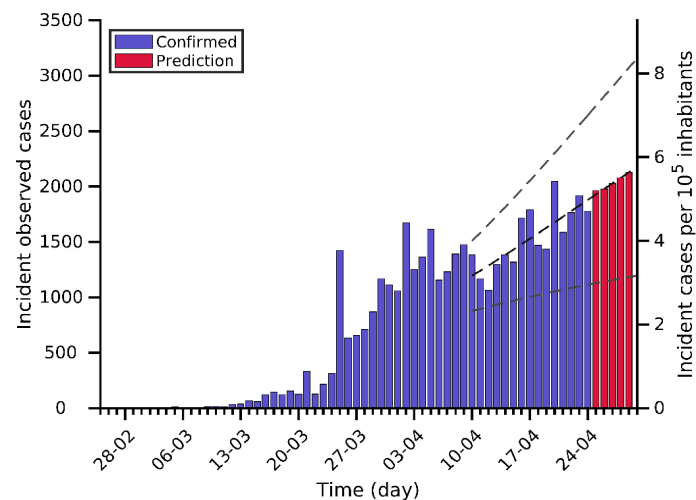
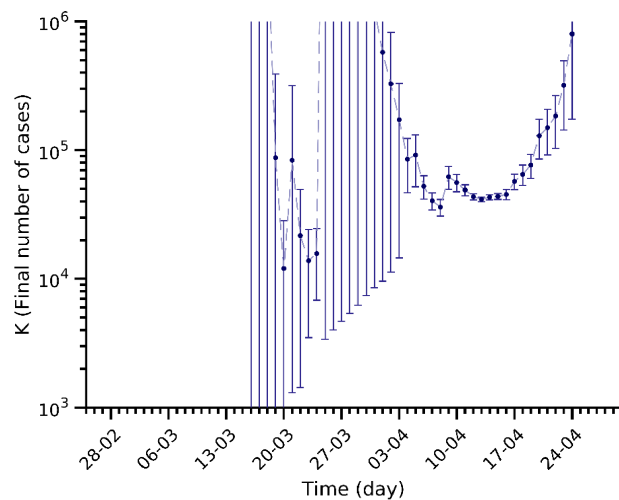
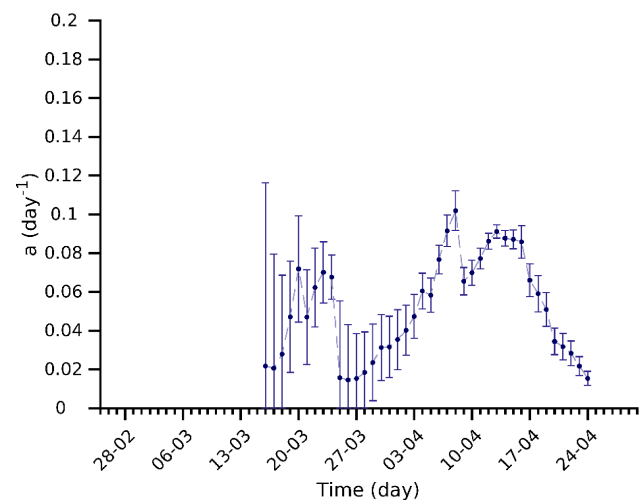
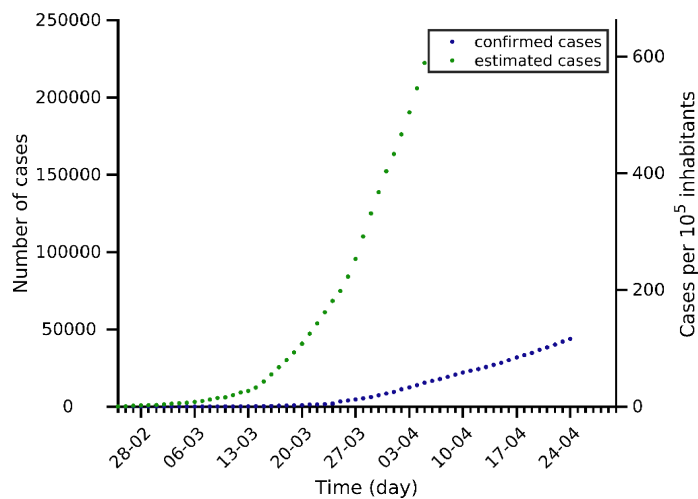
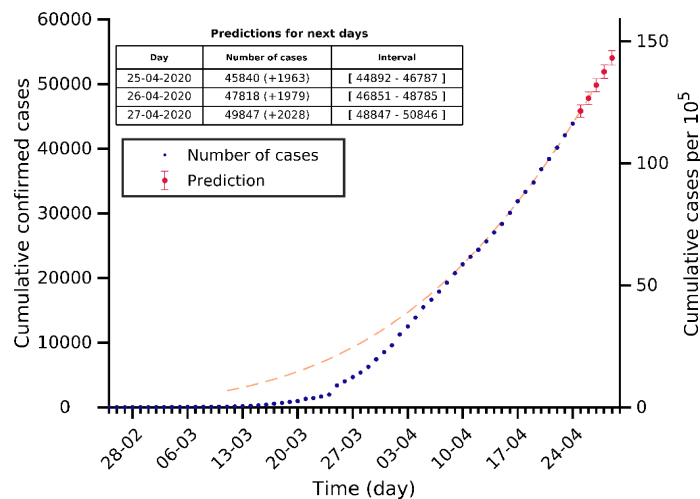




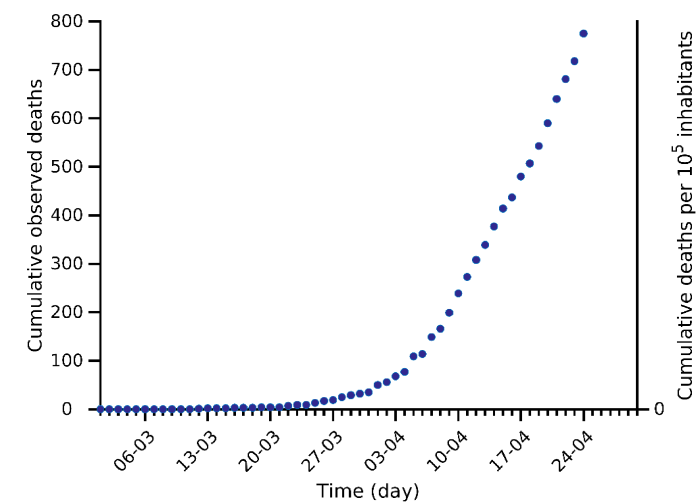
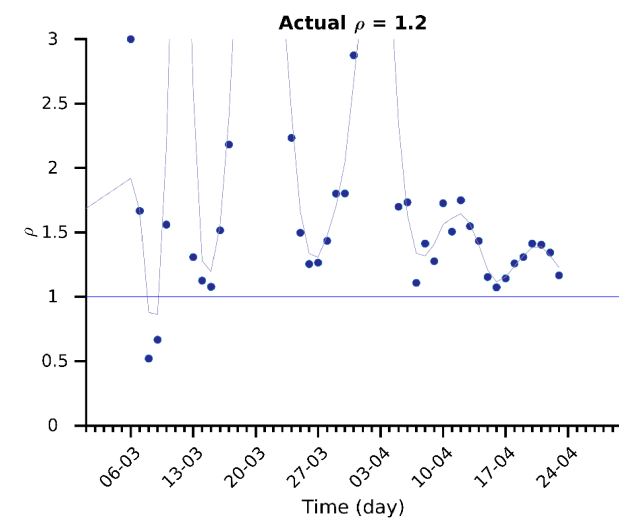
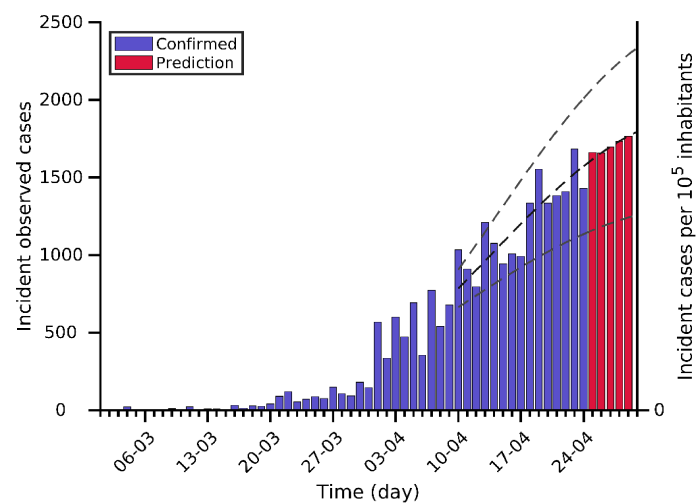
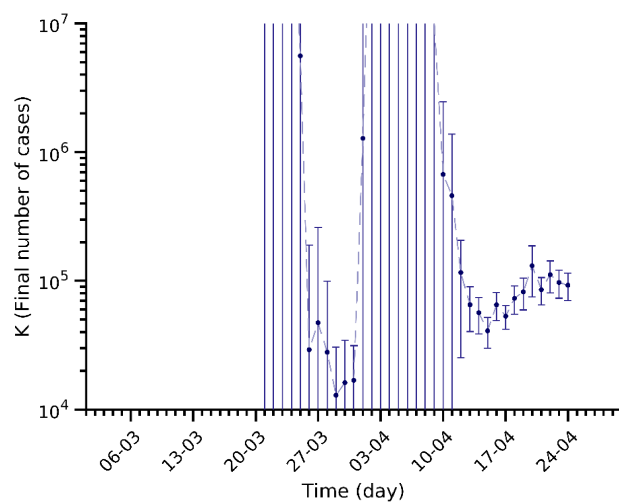
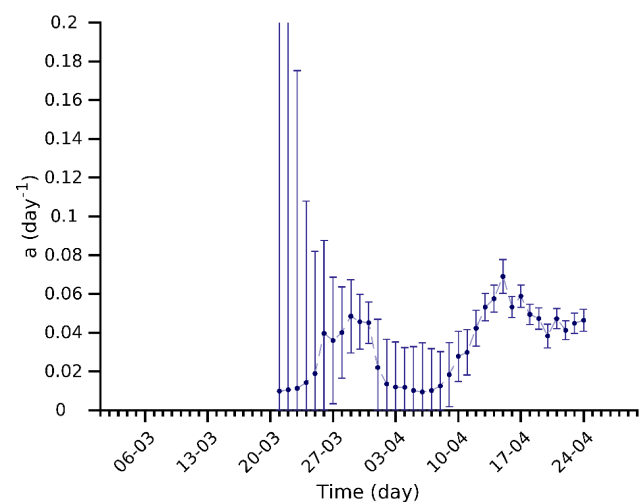
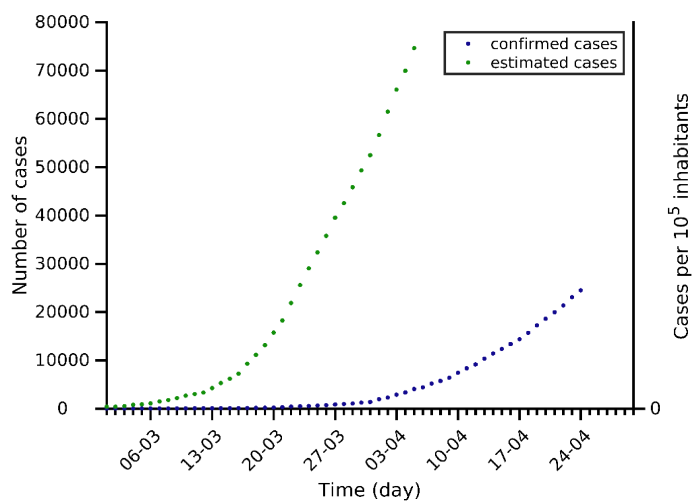
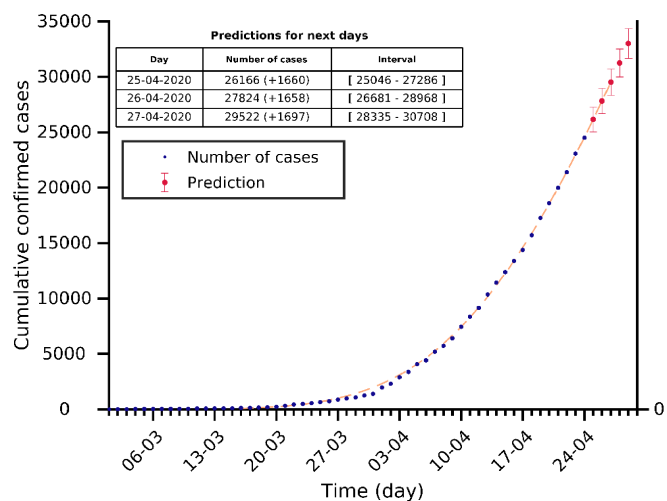
# Brazil 24-04-2020. Population: 212.6M. Current cumulated incidence: 25/10<sup>5</sup>



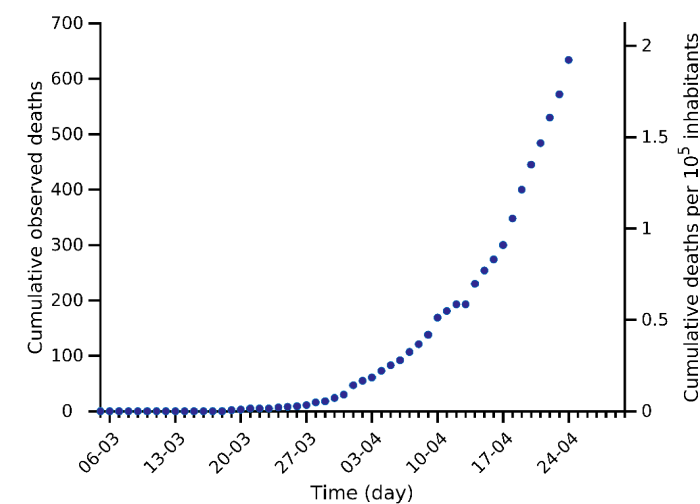
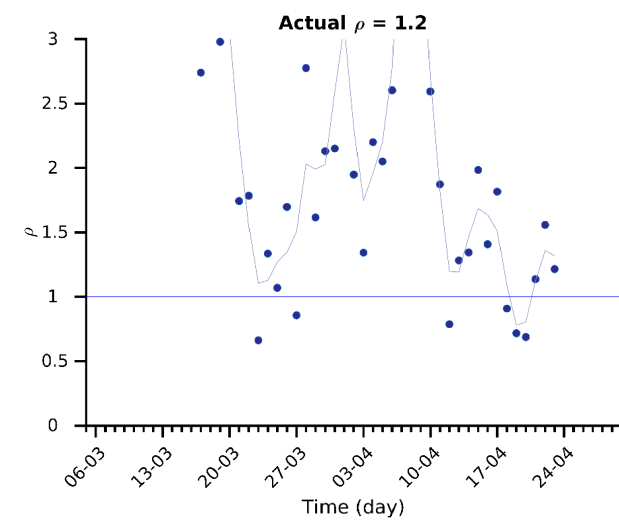
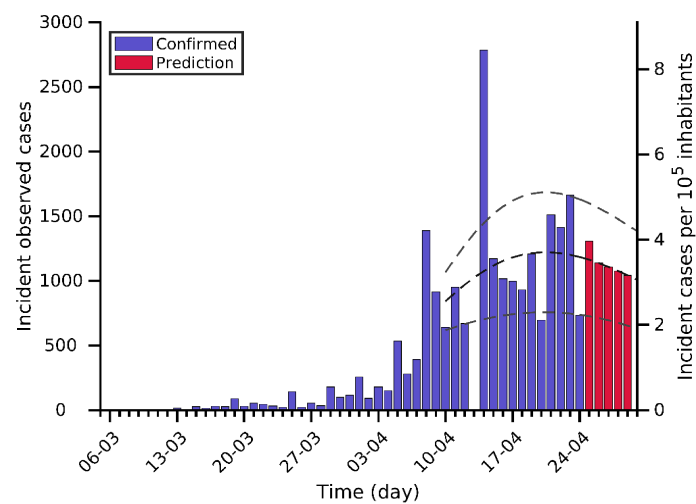
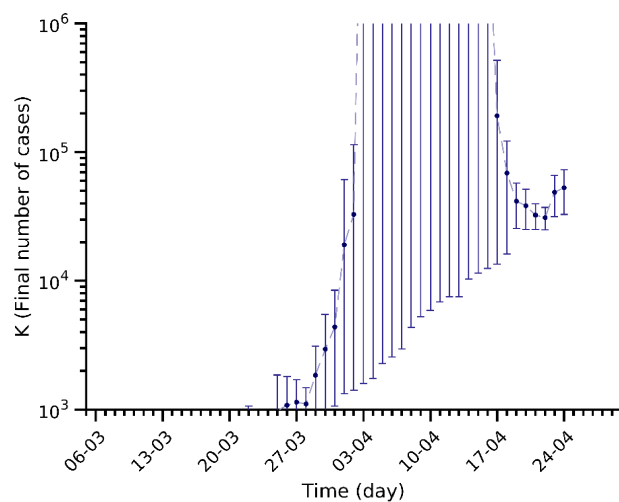
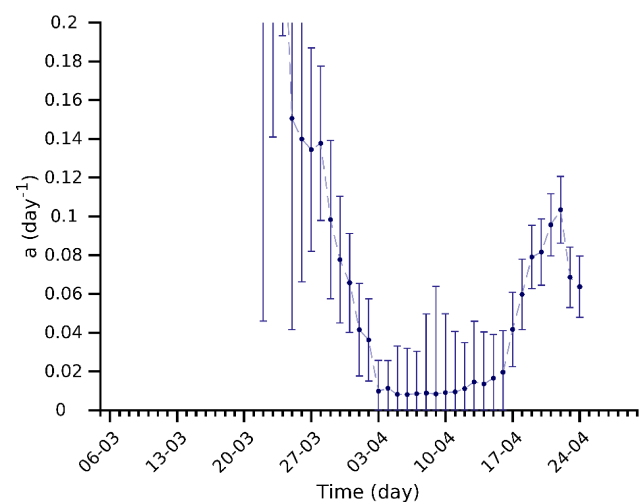
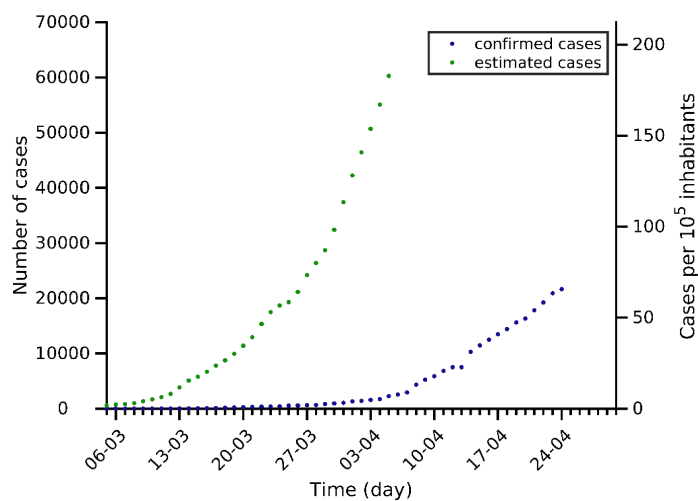
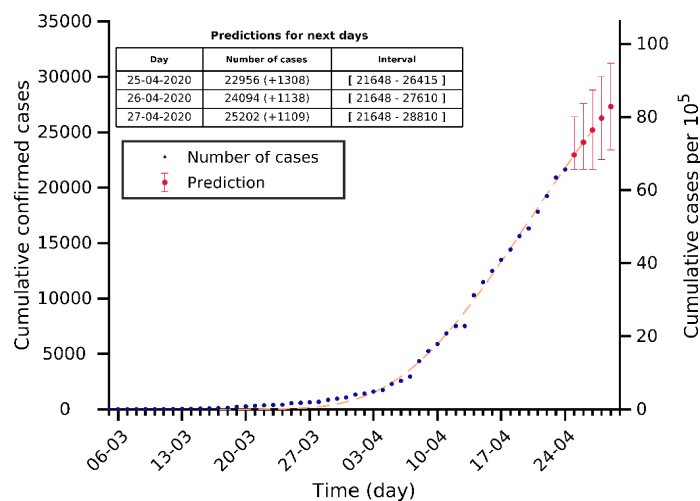
# Canada 24-04-2020. Population: 37.7M. Current cumulated incidence: 116/10<sup>5</sup>



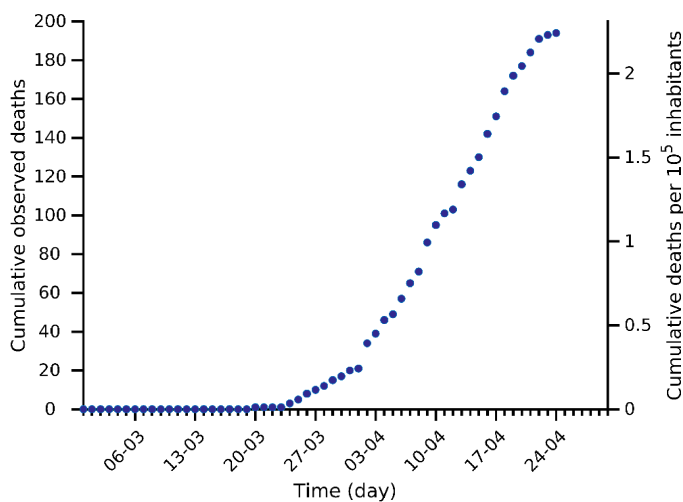
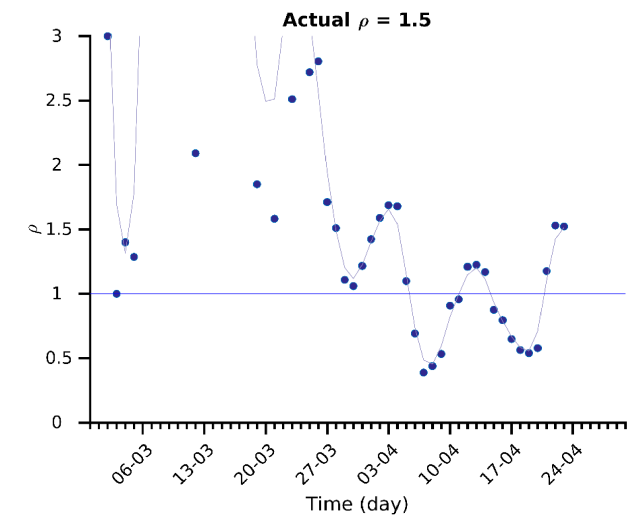
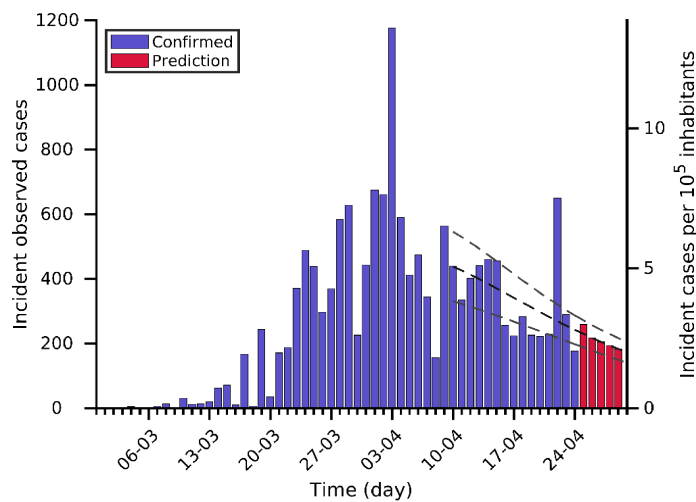
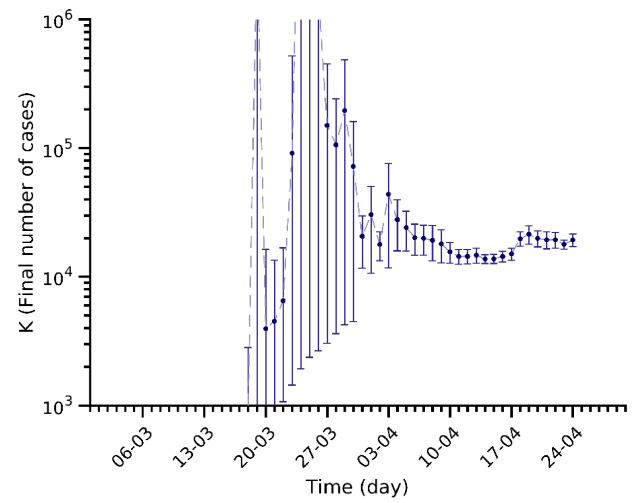
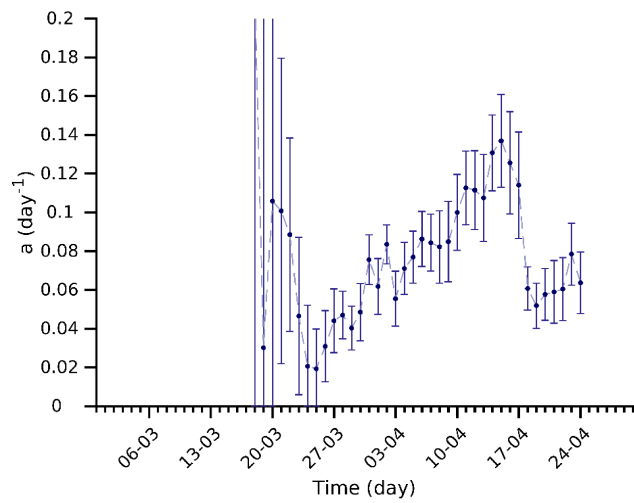
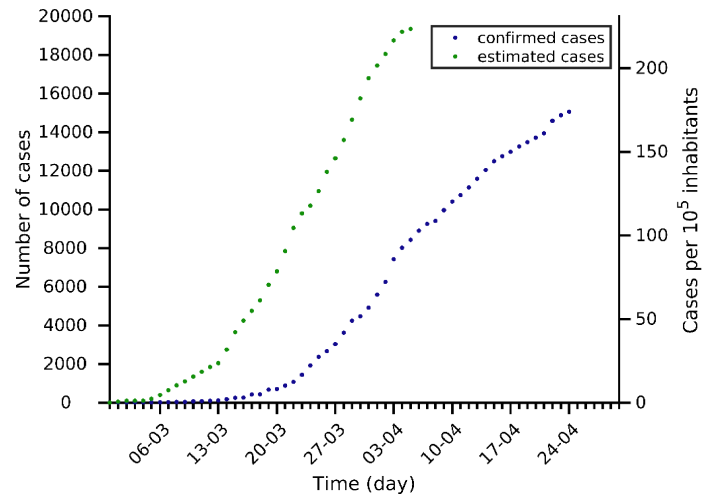
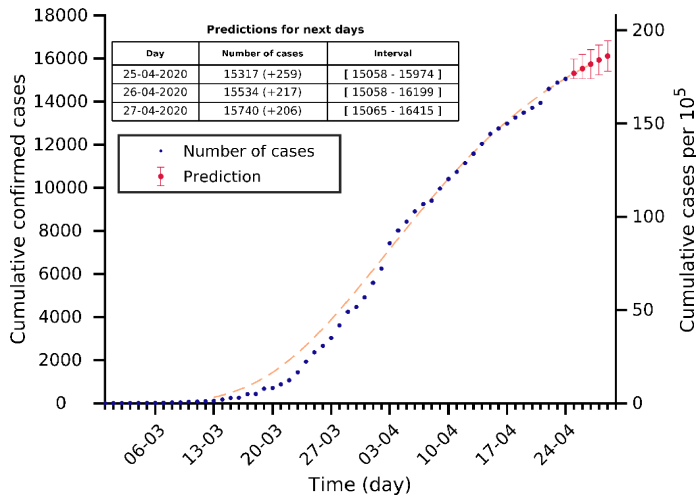
# India 24-04-2020. Population: 1353000.0M. Current cumulated incidence: 0/10<sup>5</sup>



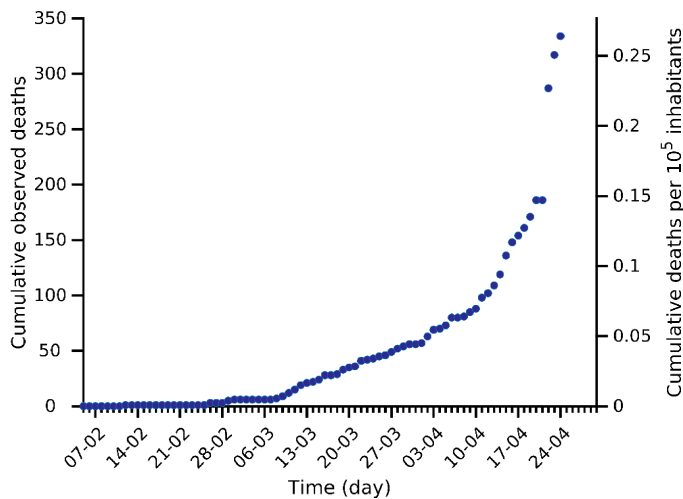
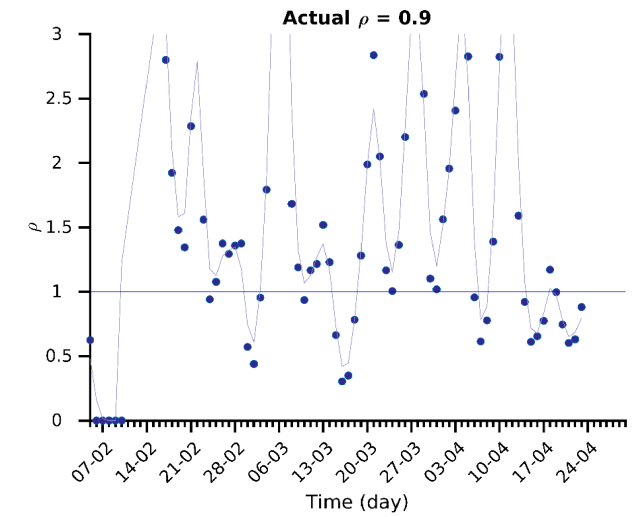
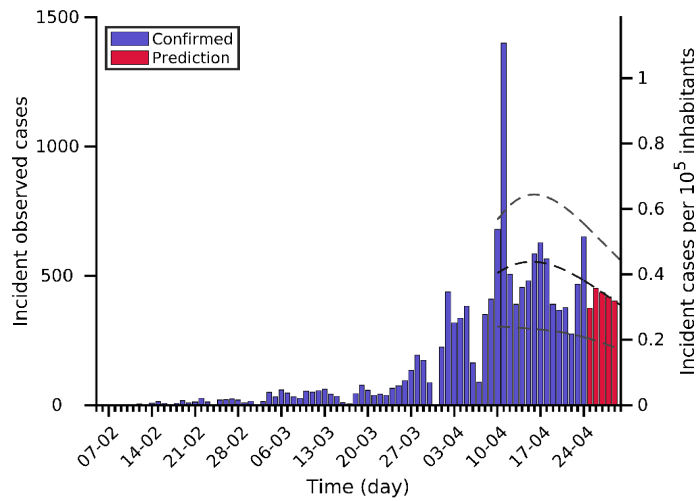
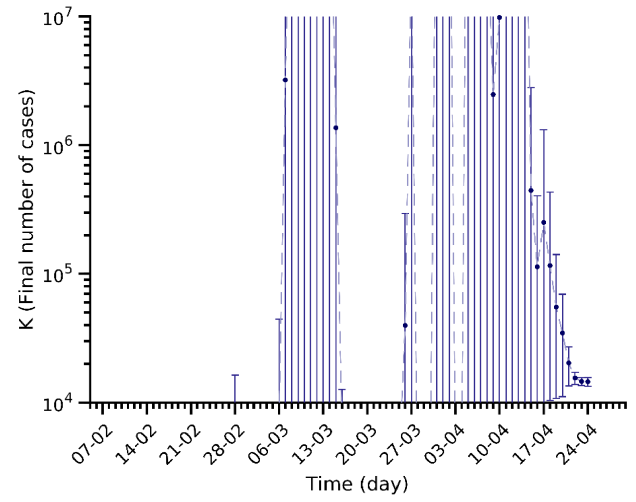
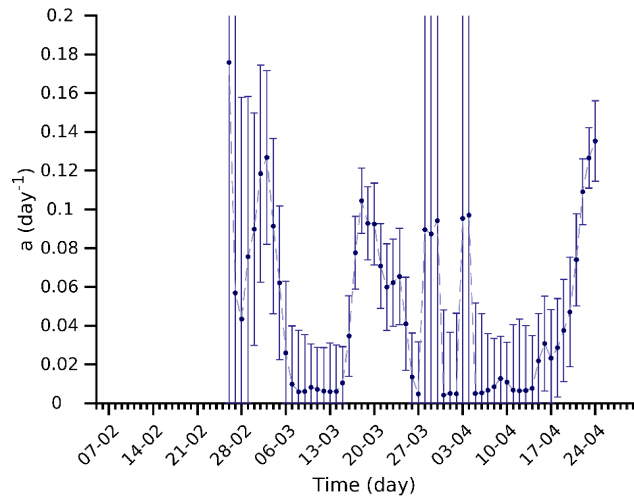
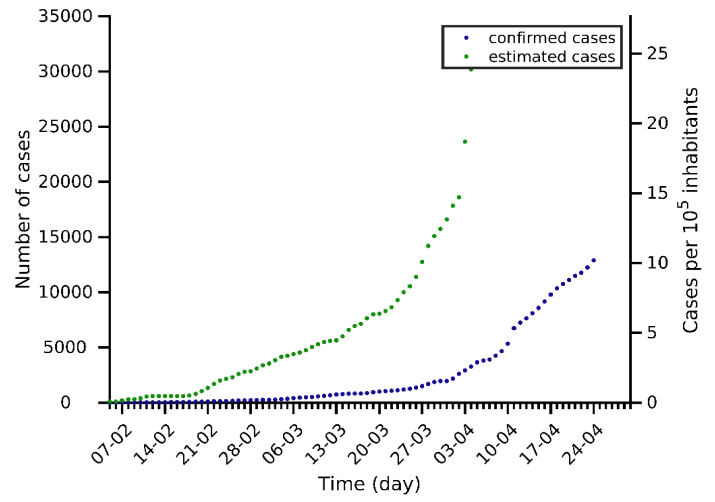
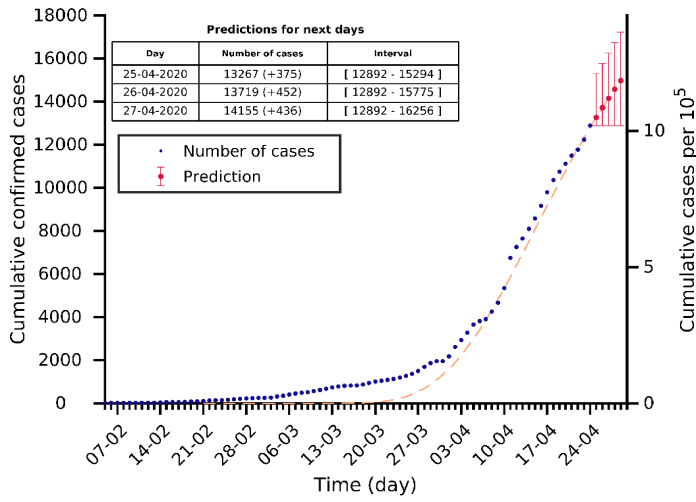
# Peru 24-04-2020. Population: 33.0M. Current cumulated incidence: 66/10<sup>5</sup>



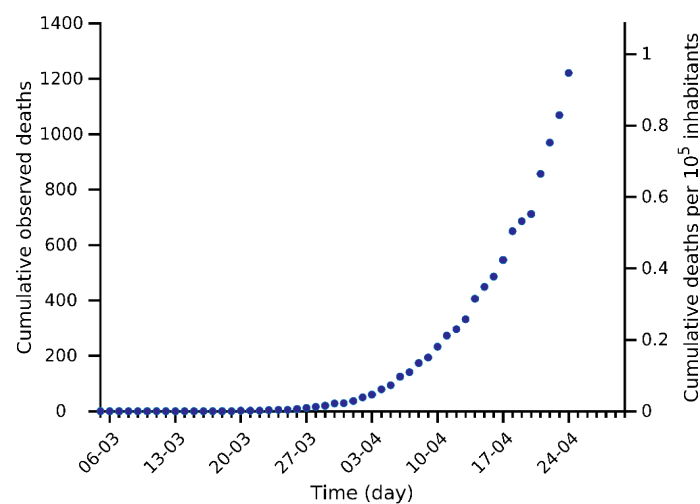
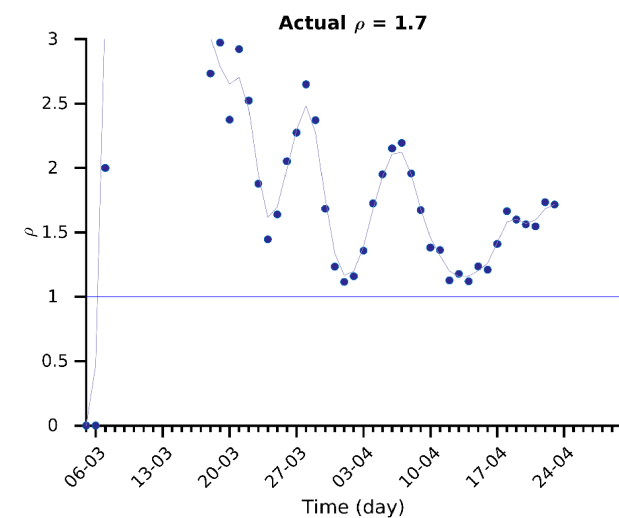
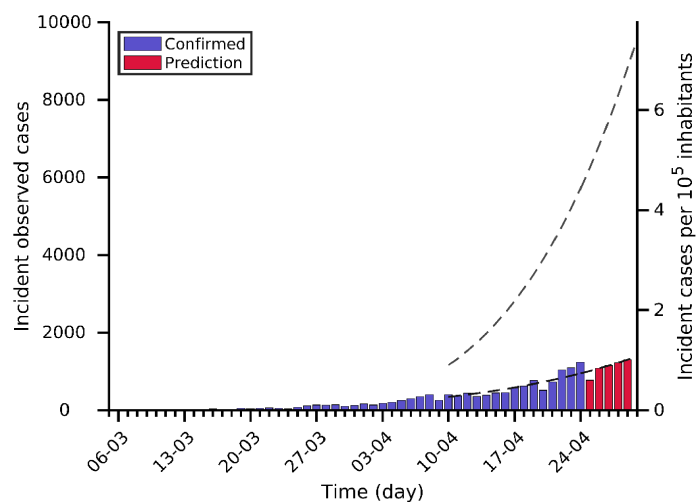
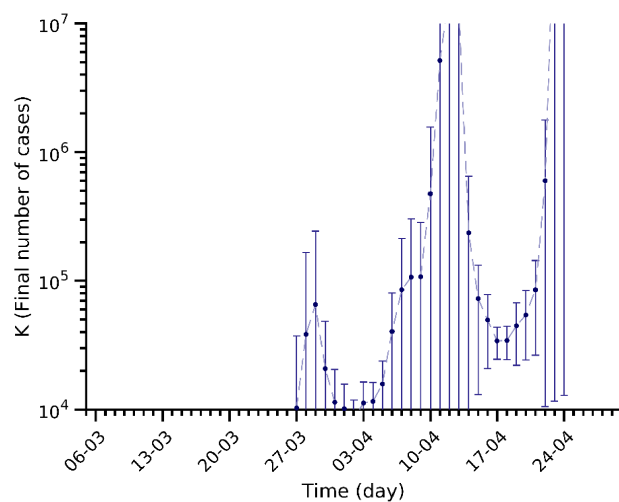
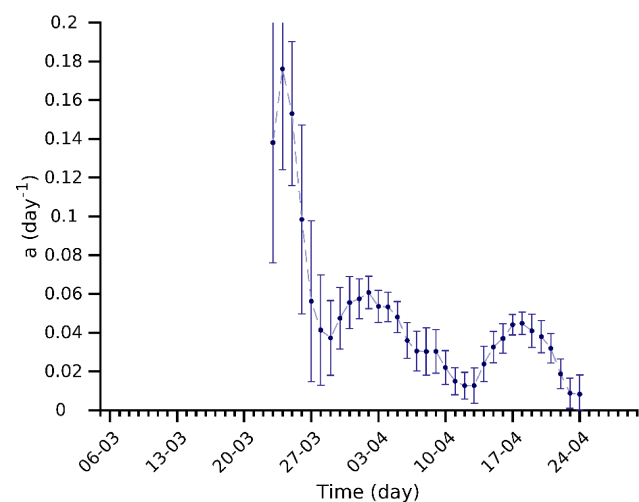
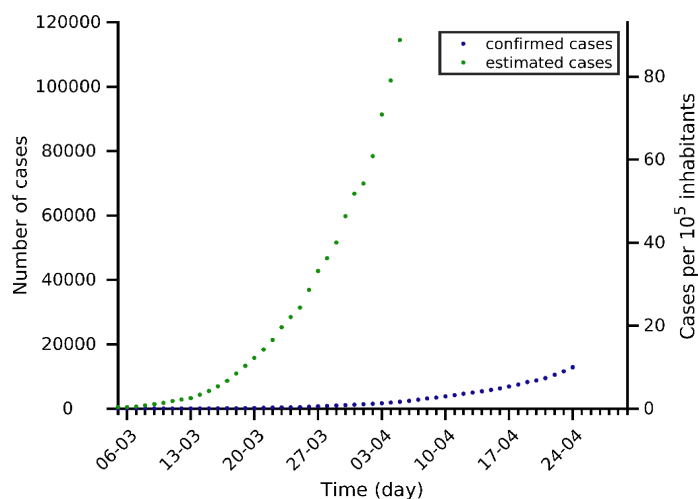
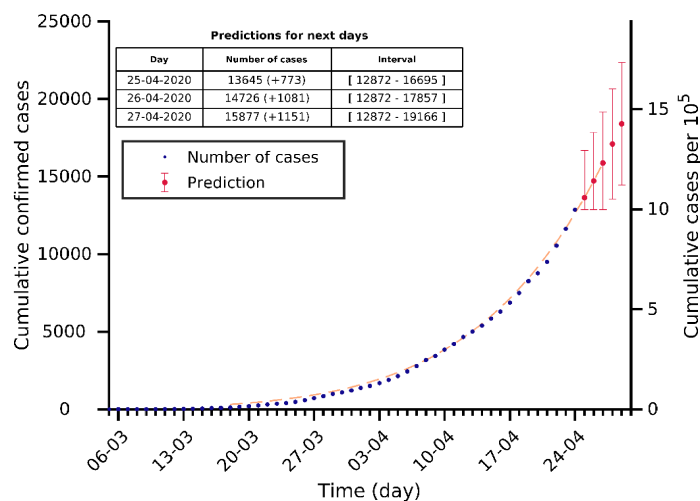
# Israel 24-04-2020. Population: 8.7M. Current cumulated incidence: 174/10<sup>5</sup>



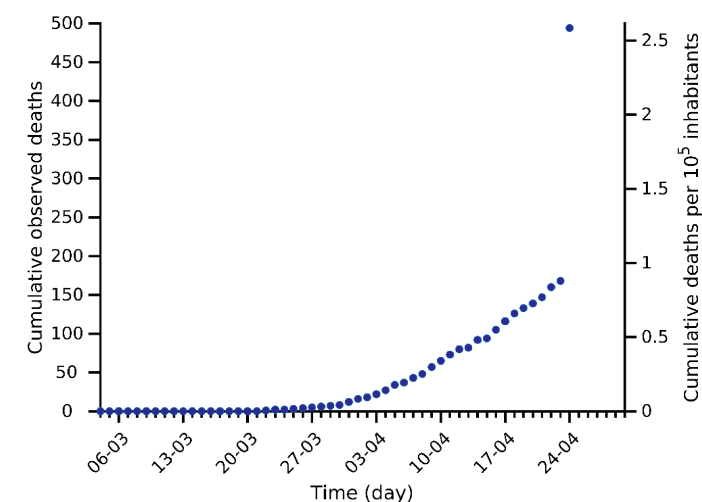
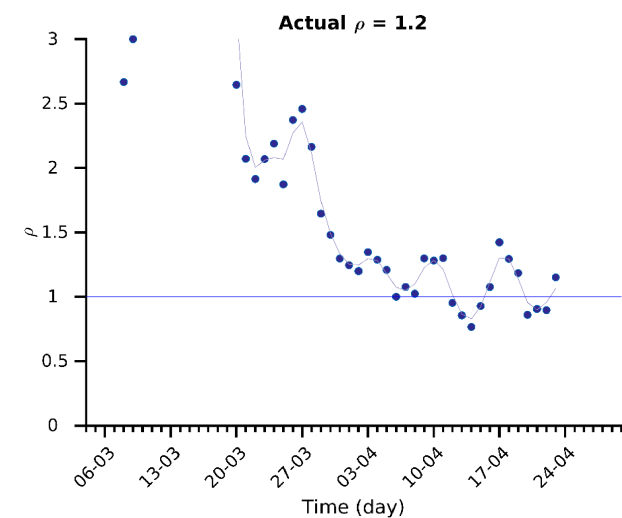
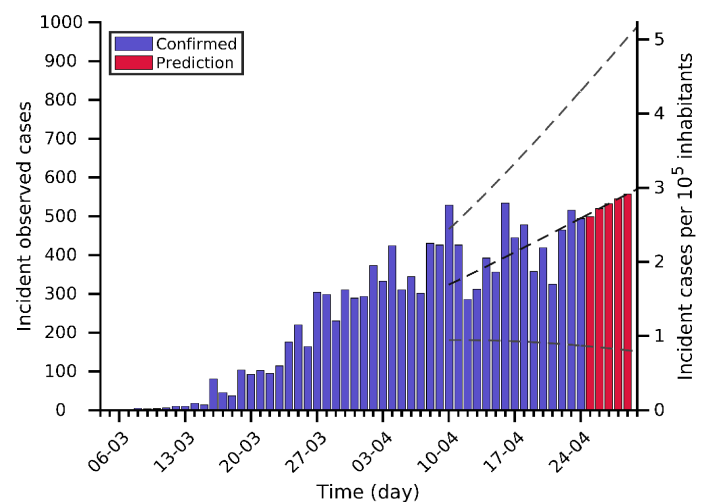
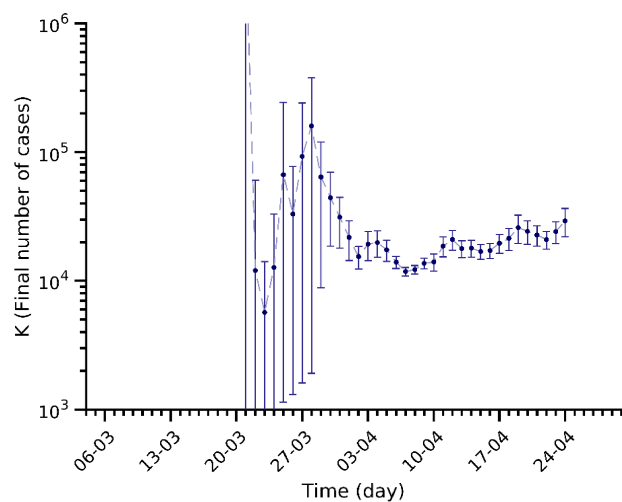
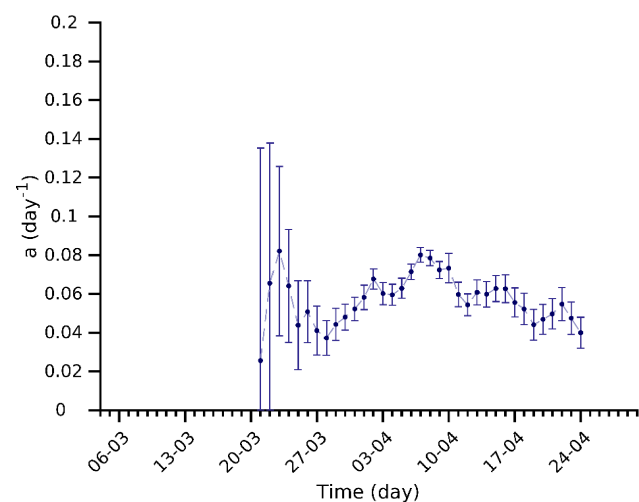
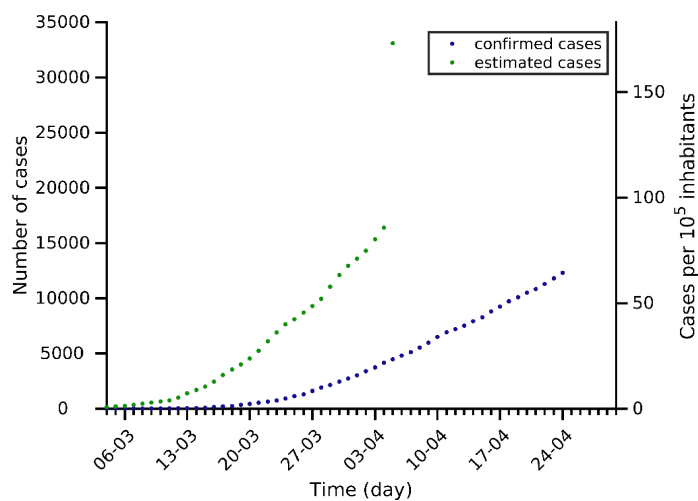
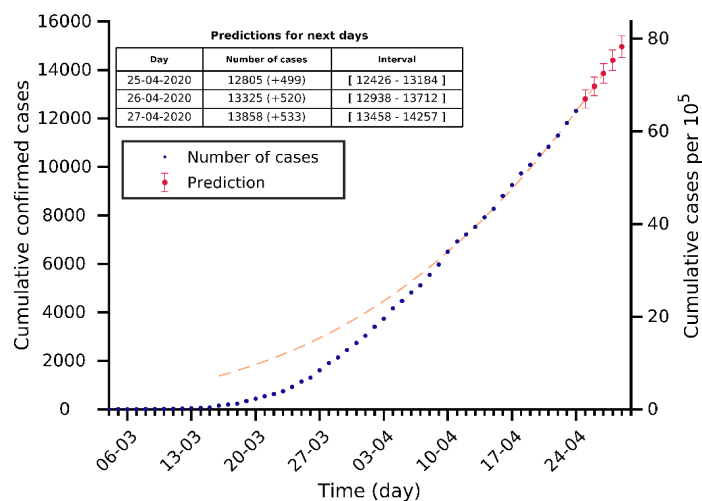
# Japan 24-04-2020. Population: 126.5M. Current cumulated incidence: 10/10<sup>5</sup>



# Mexico 24-04-2020. Population: 128.9M. Current cumulated incidence: 10/10<sup>5</sup>

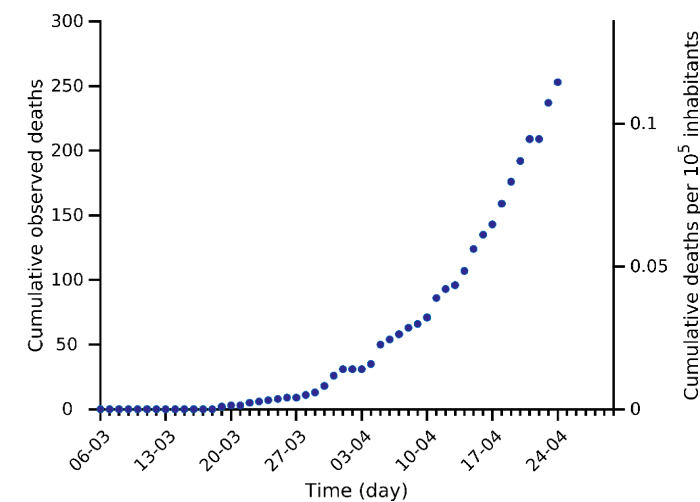
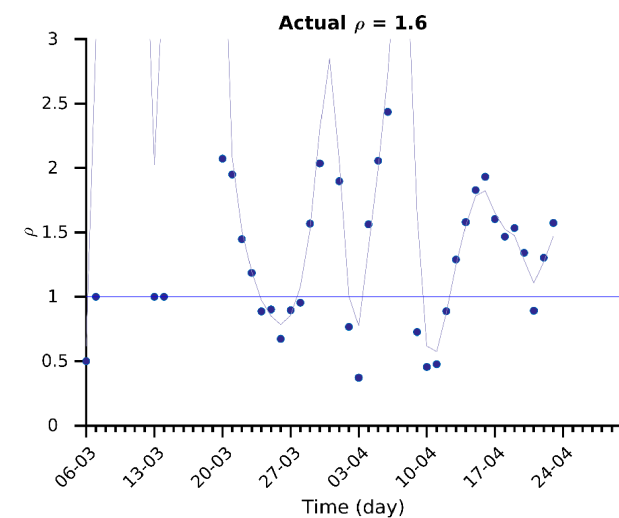
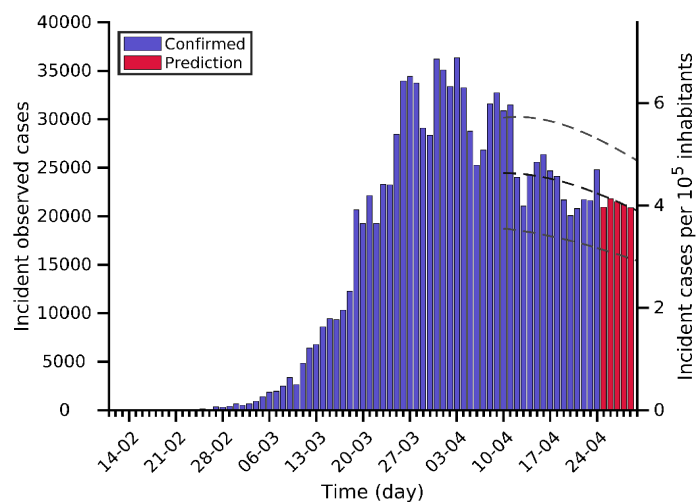
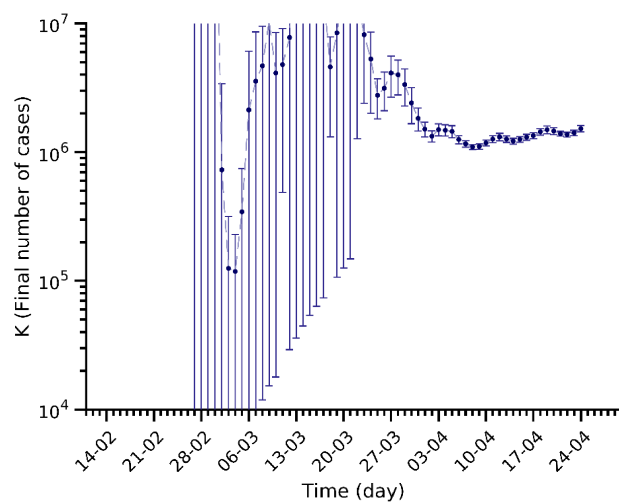
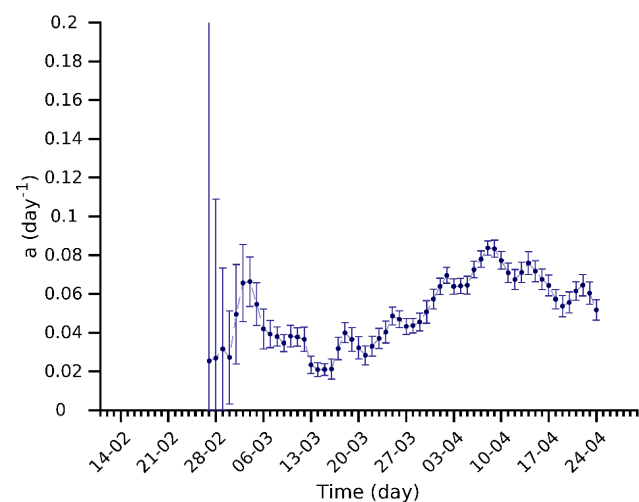
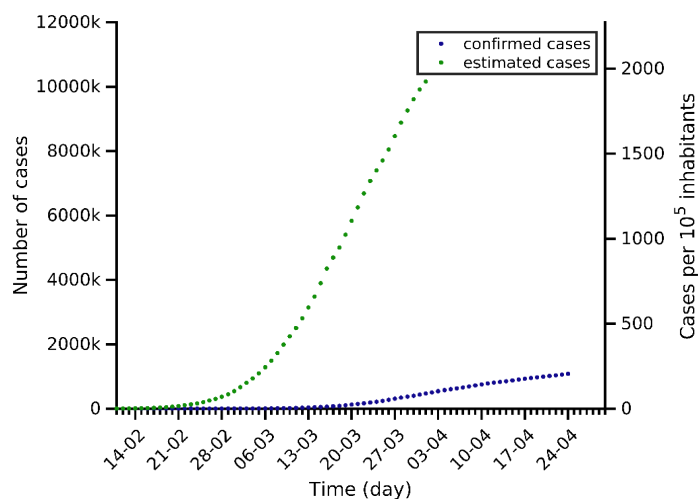
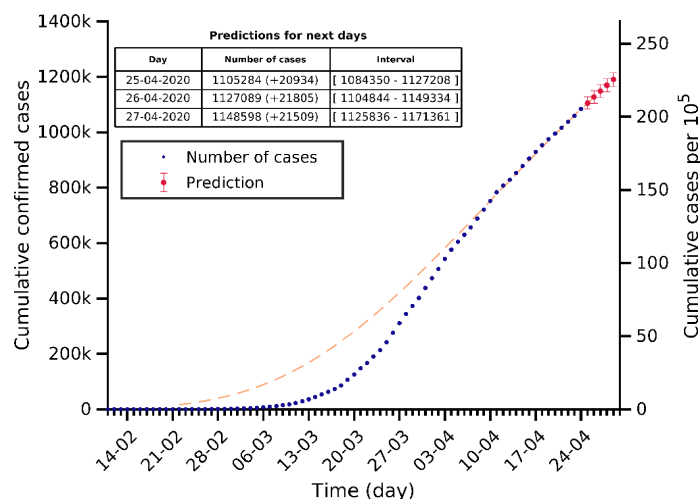


# Chile 24-04-2020. Population: 19.1M. Current cumulated incidence: 64/10<sup>5</sup>

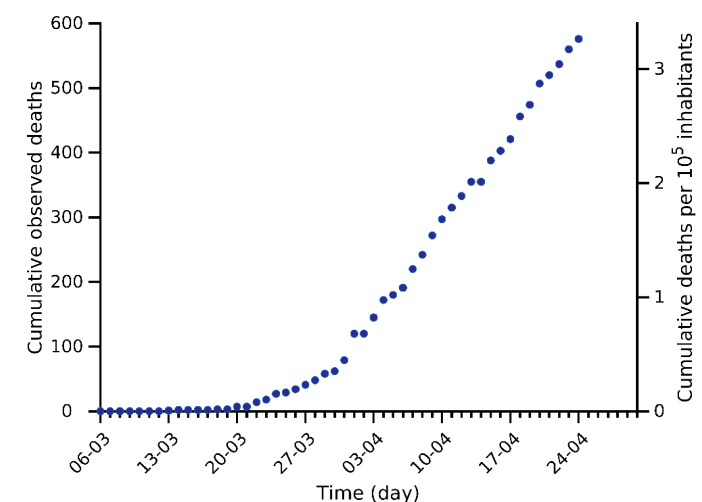
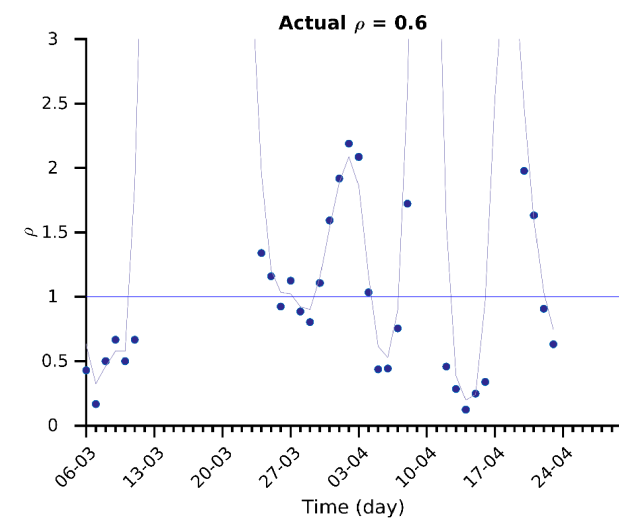
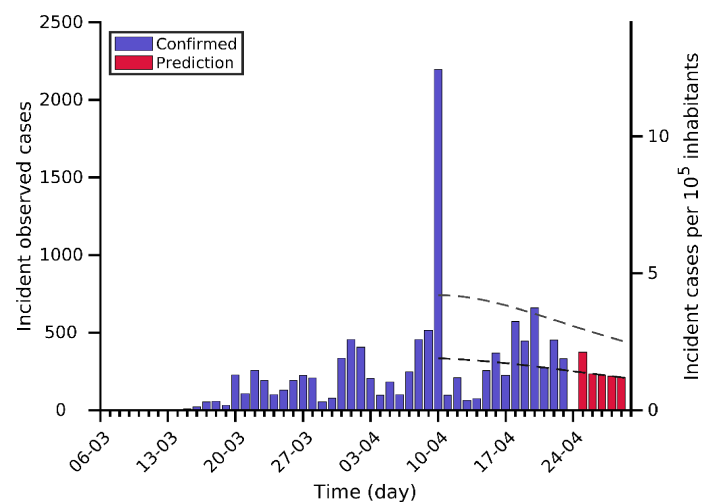
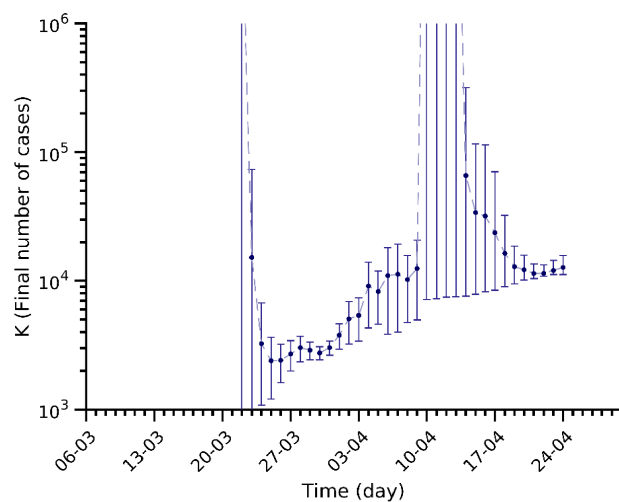
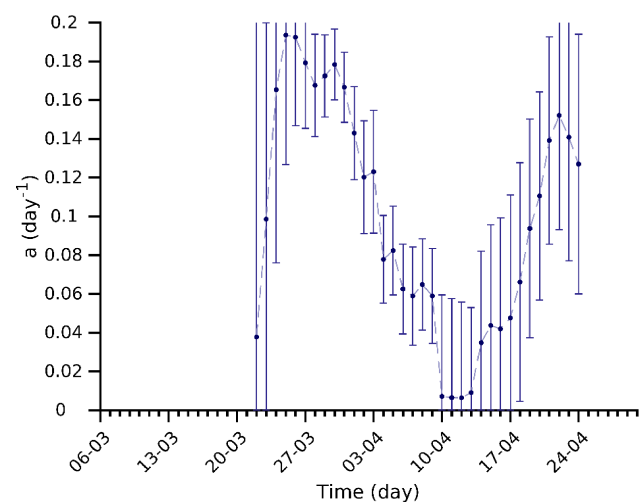
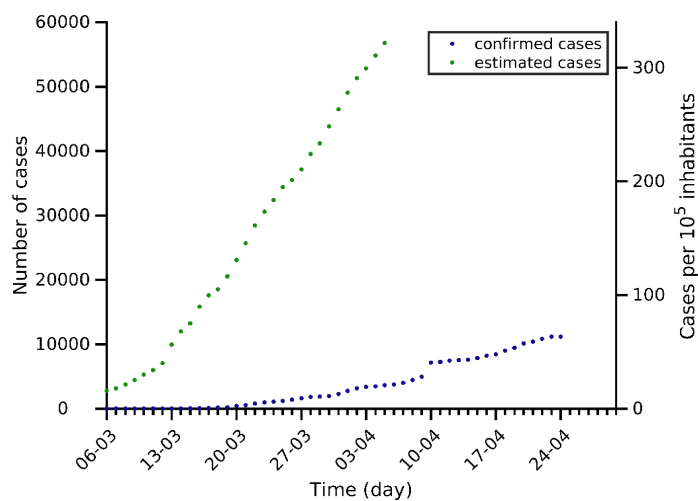
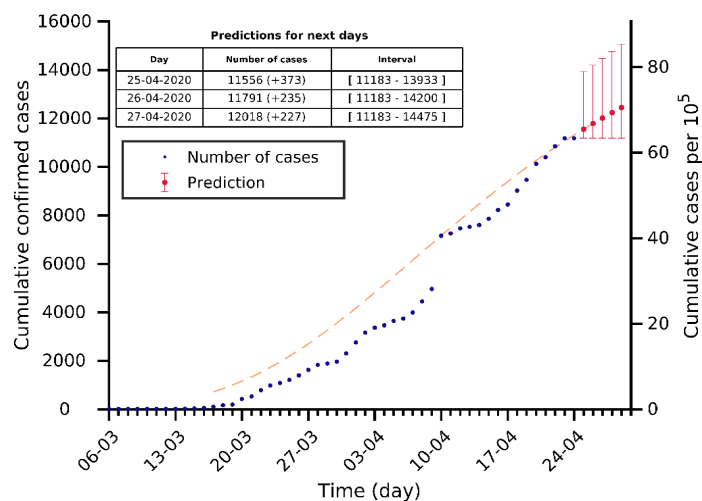




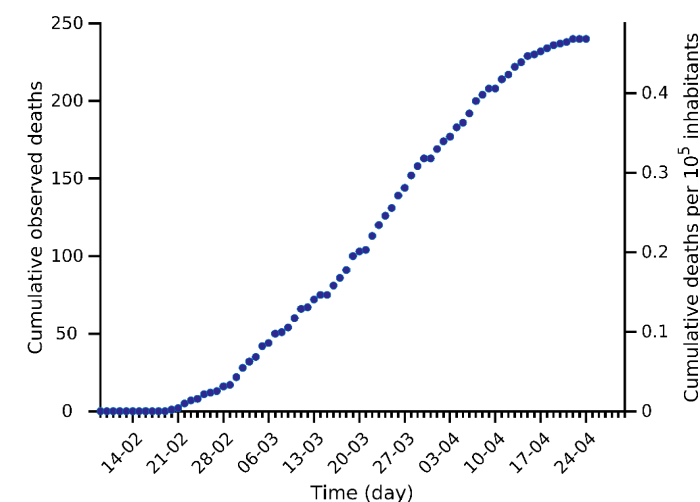
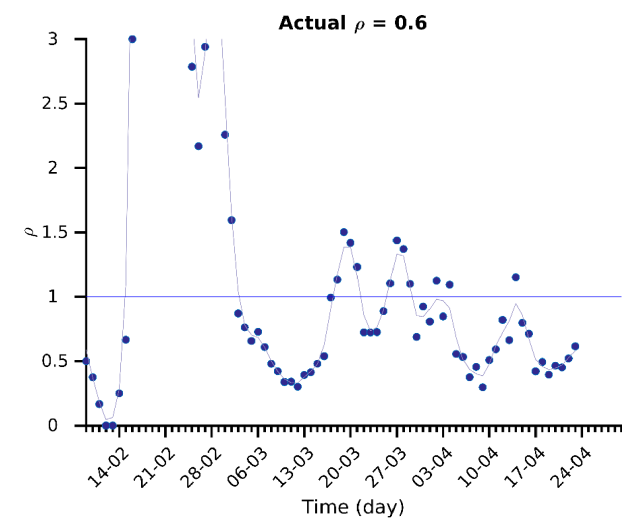
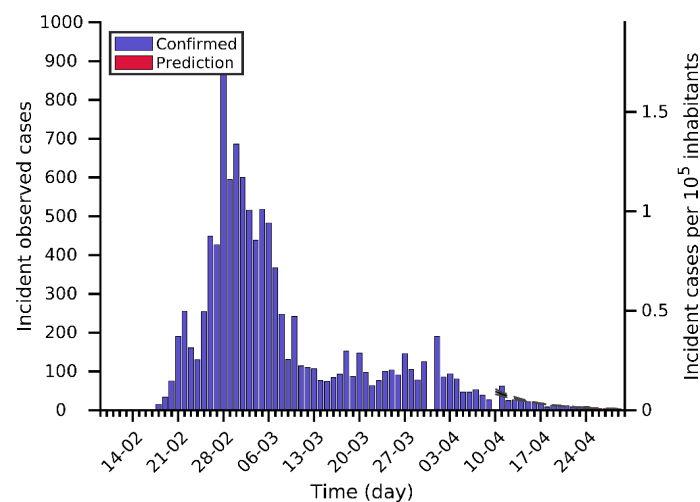
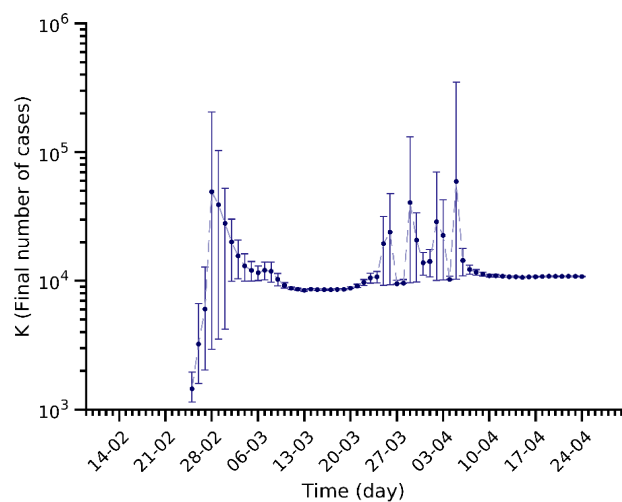
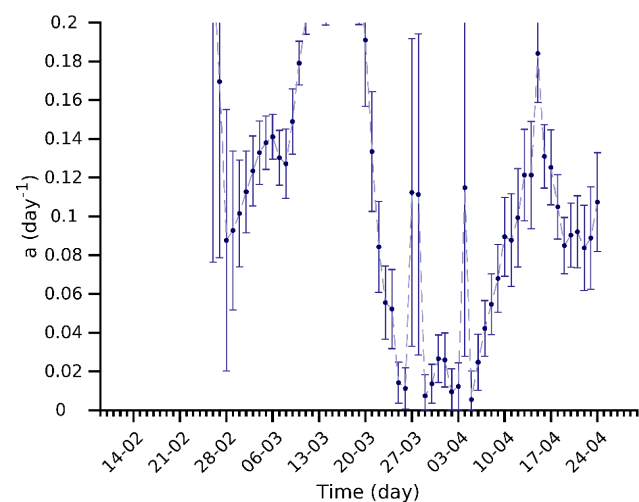
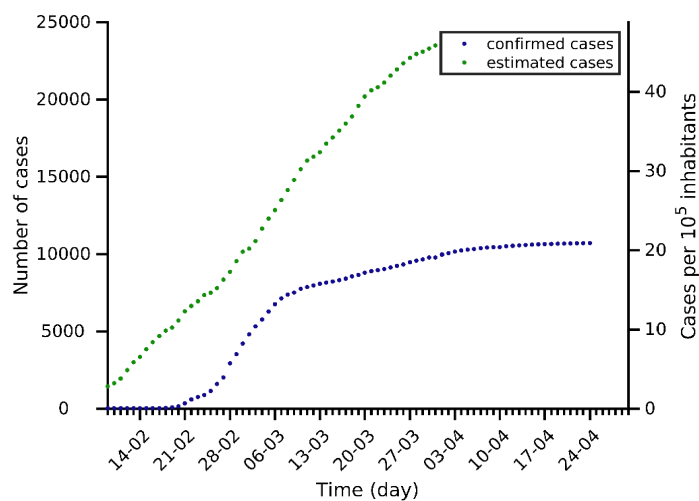
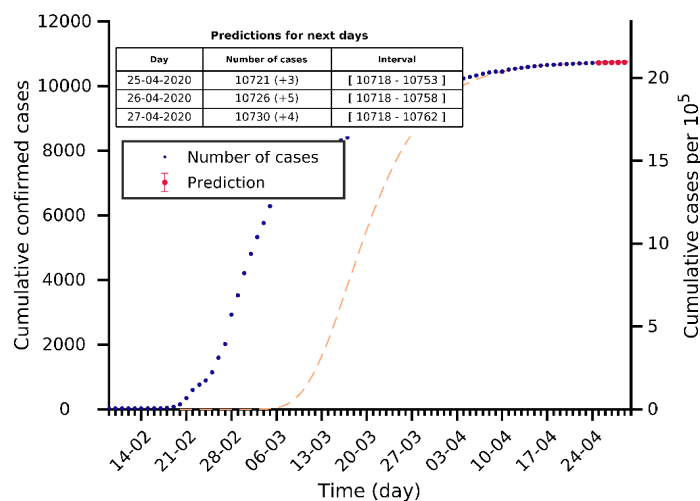
# Pakistan 24-04-2020. Population: 220.9M. Current cumulated incidence: 5/10<sup>5</sup>



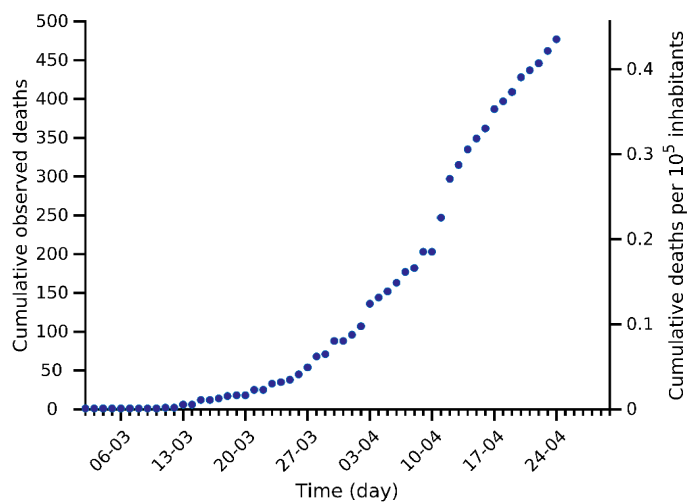
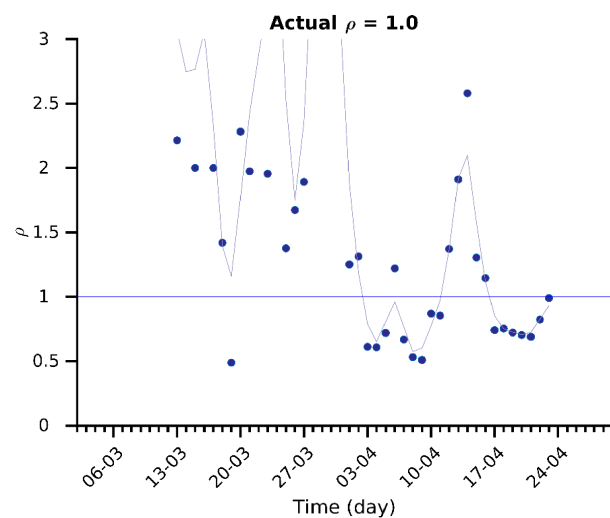
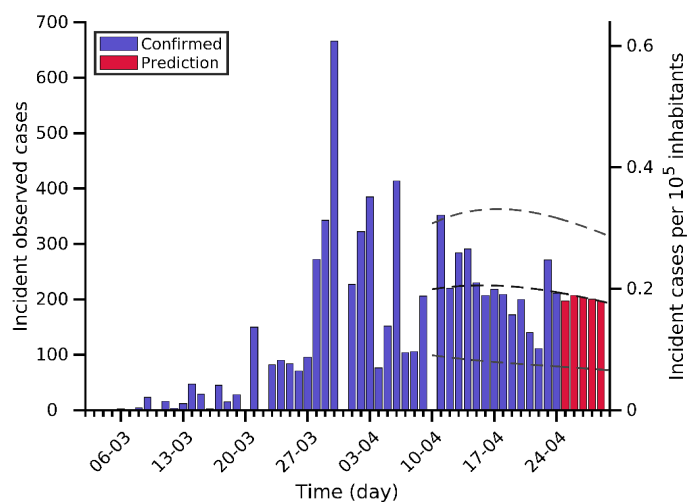
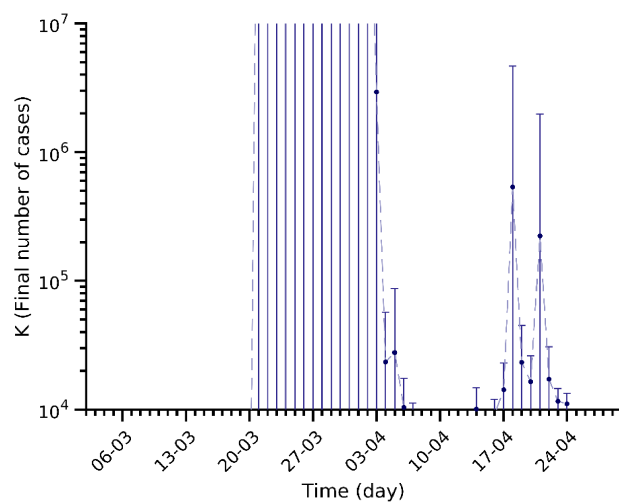
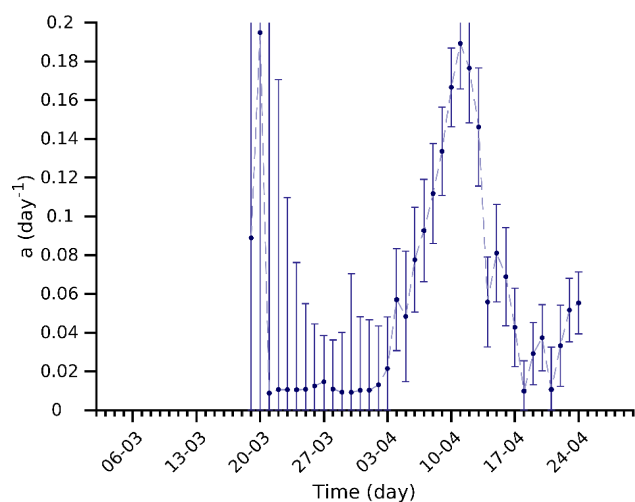
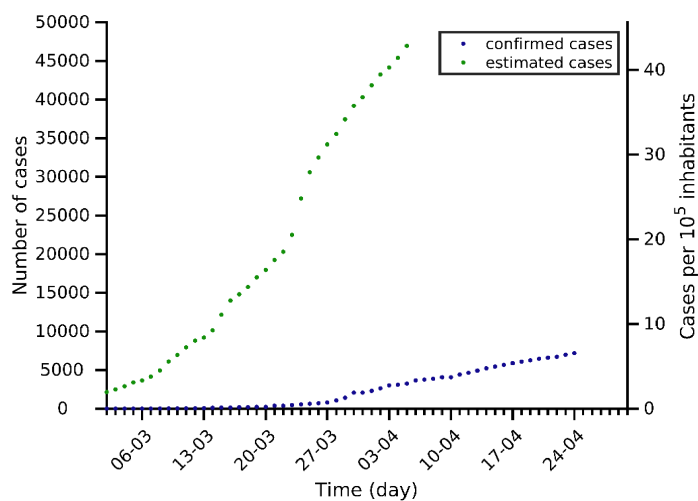
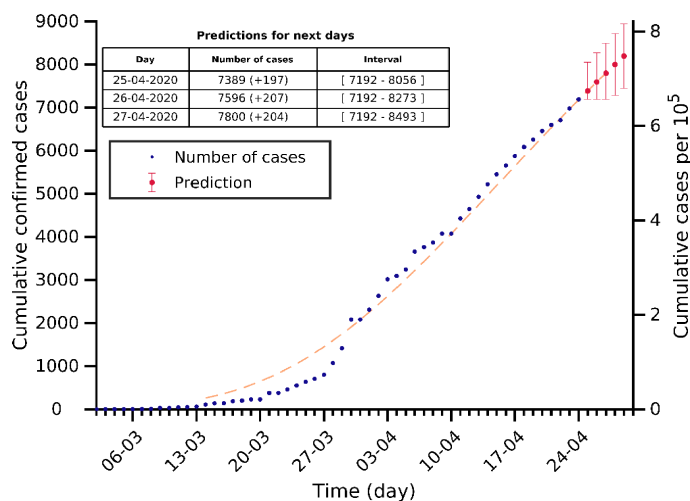
# Ecuador 24-04-2020. Population: 17.6M. Current cumulated incidence: 63/10<sup>5</sup>



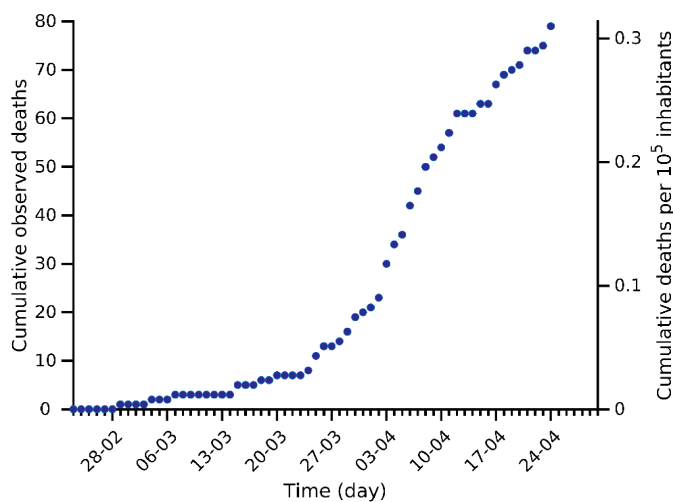
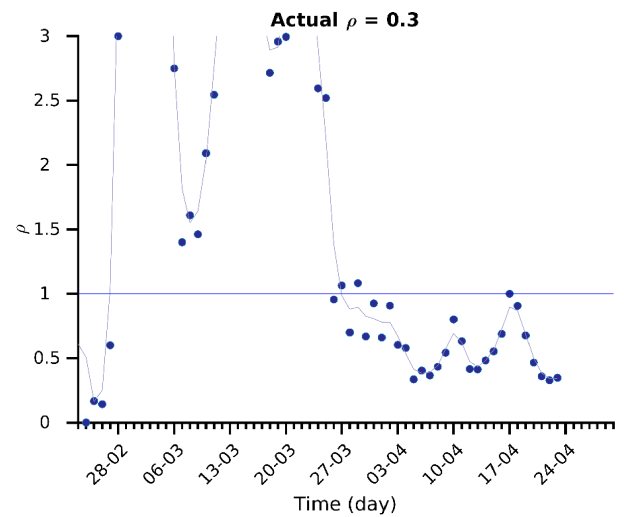
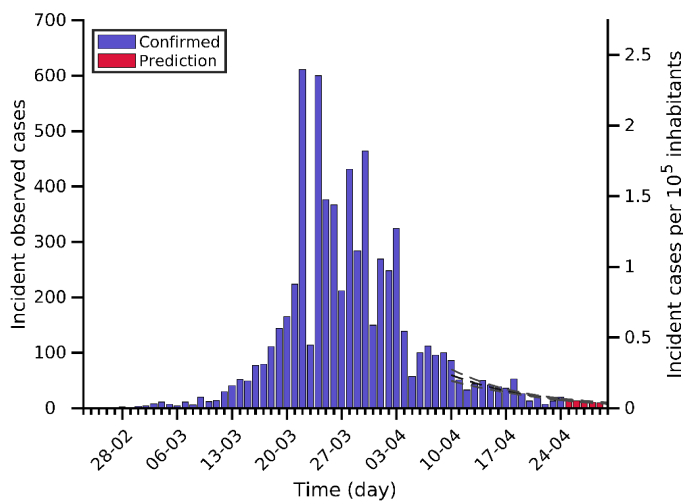
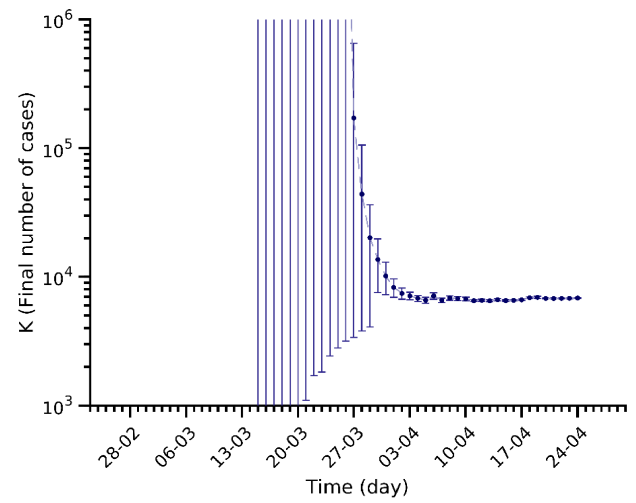
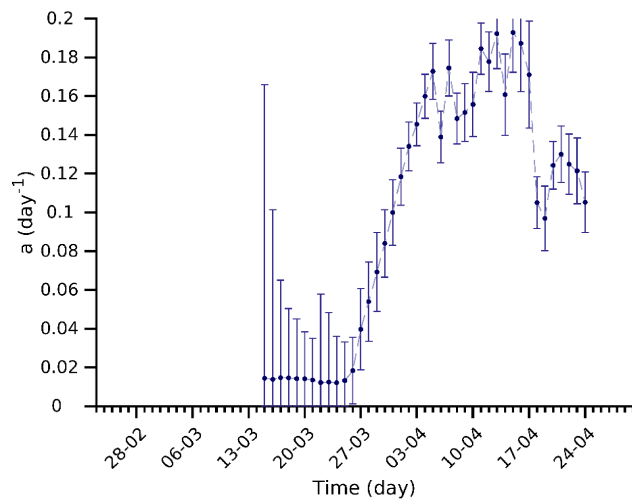
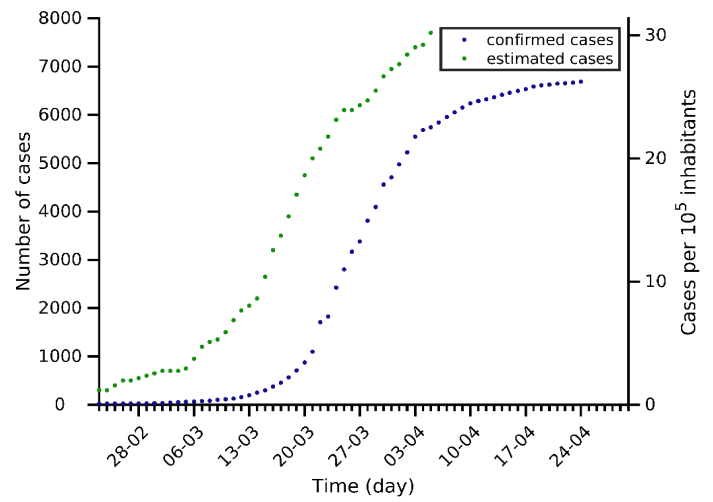
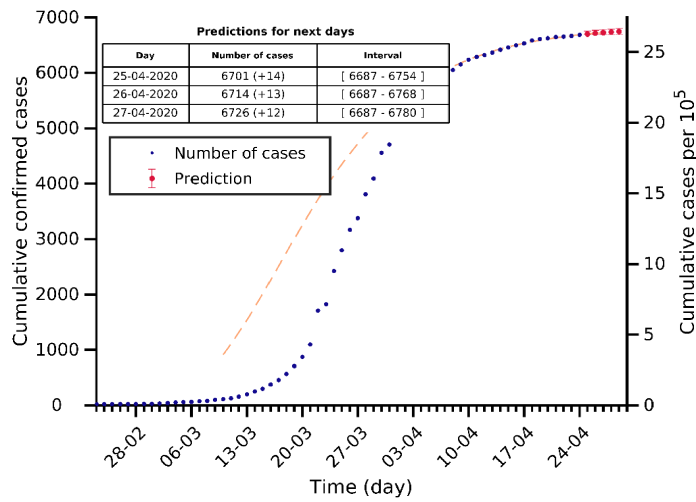
# South Korea 24-04-2020. Population: 51.3M. Current cumulated incidence: 21/10<sup>5</sup>



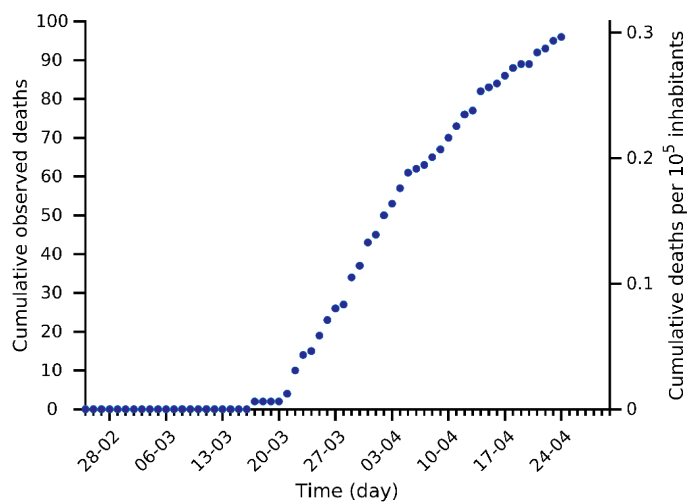
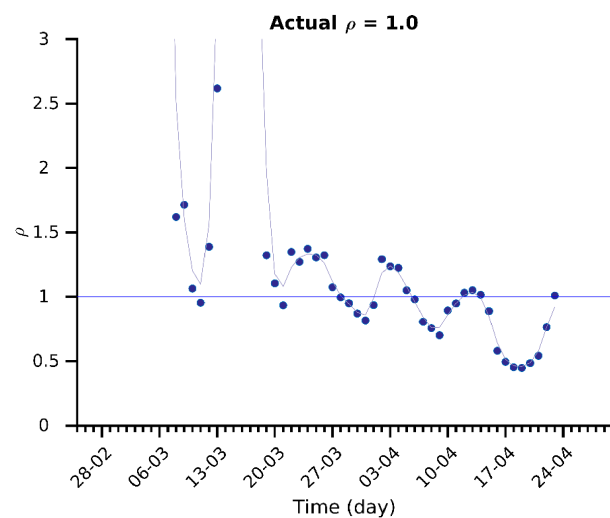
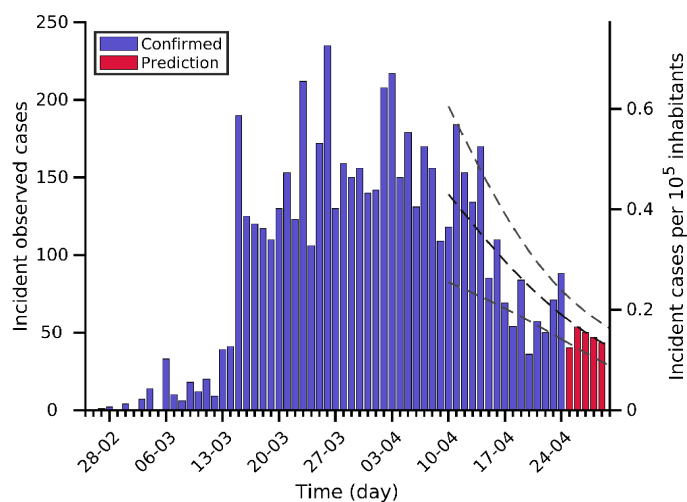
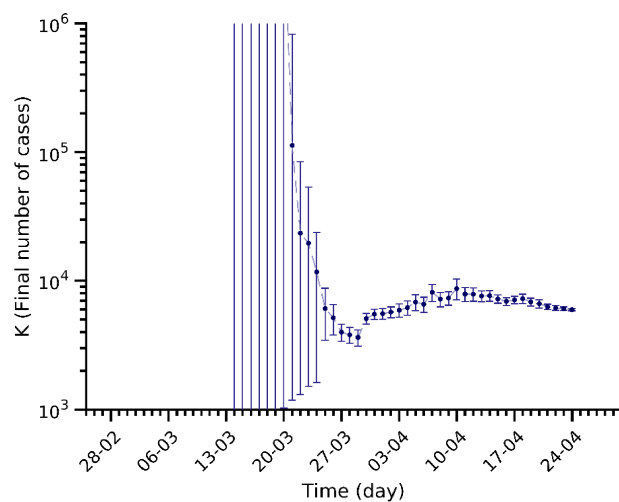
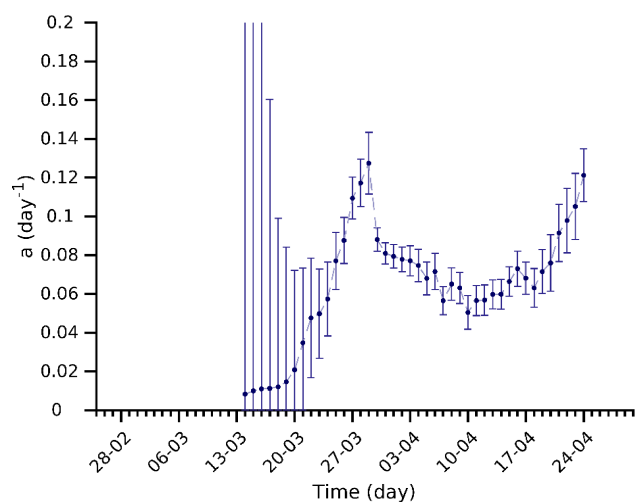
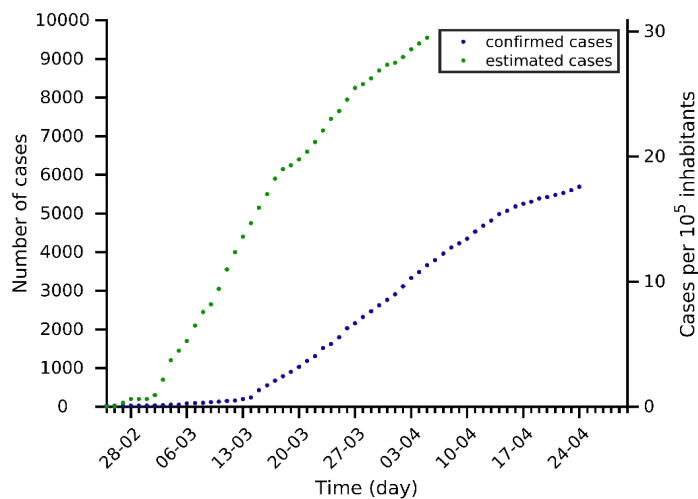
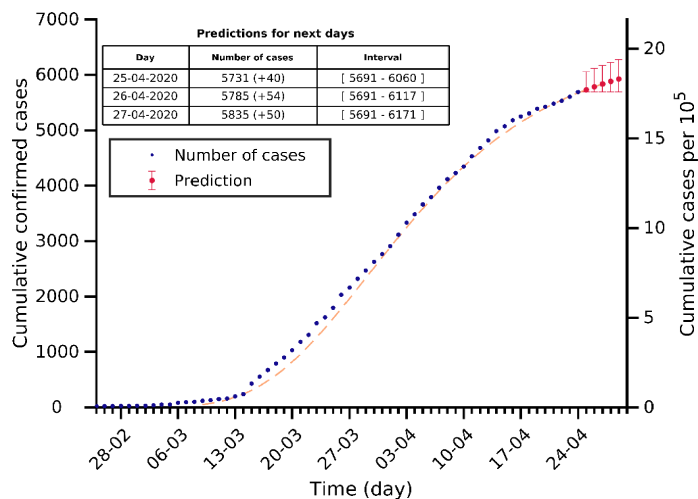
# Philippines 24-04-2020. Population: 109.6M. Current cumulated incidence: 7/10<sup>5</sup>



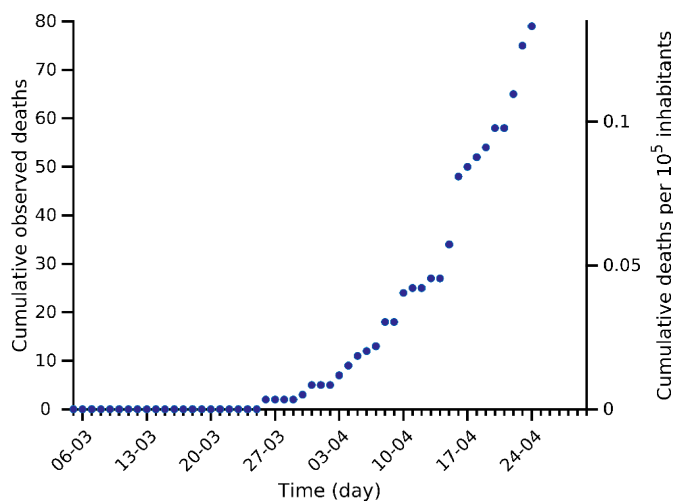
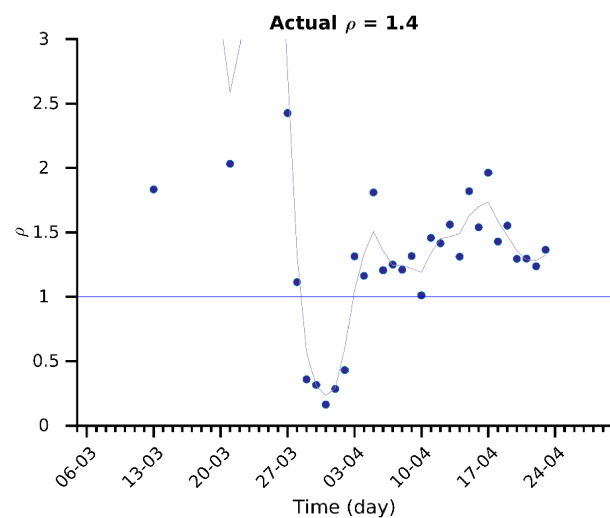
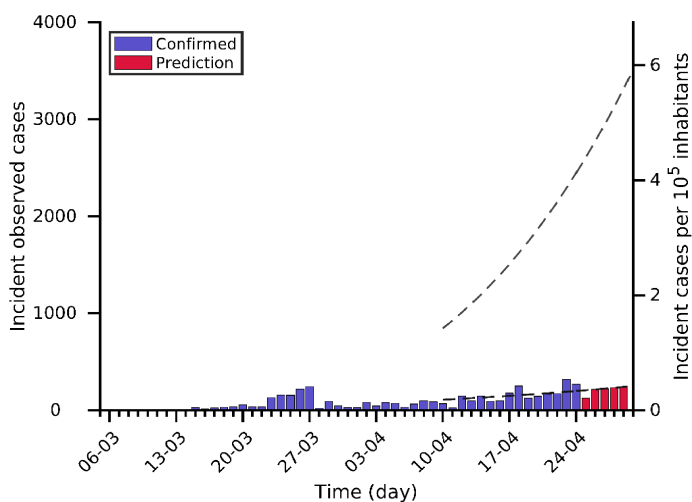
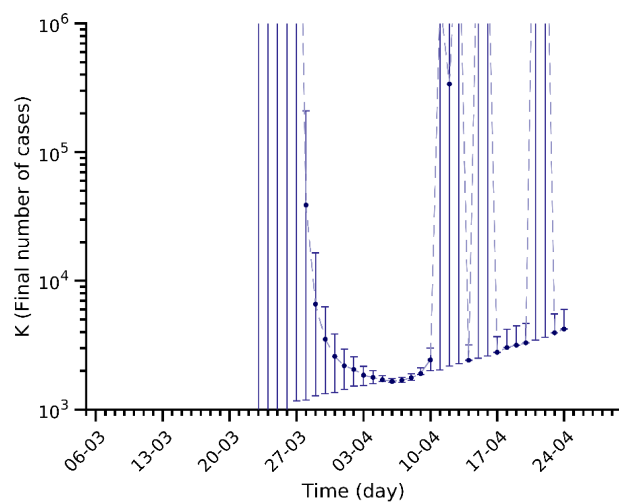
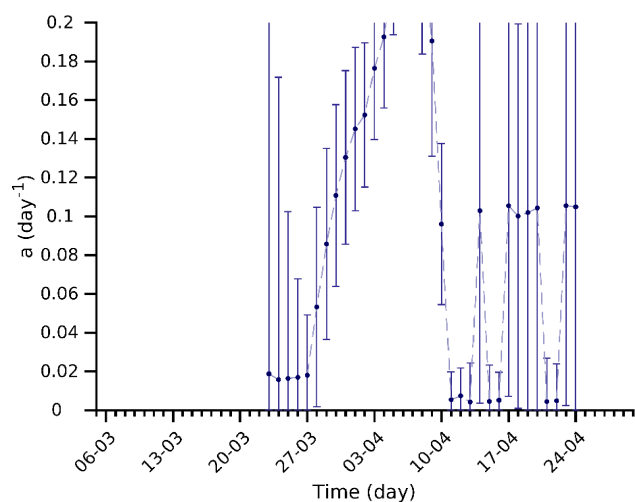
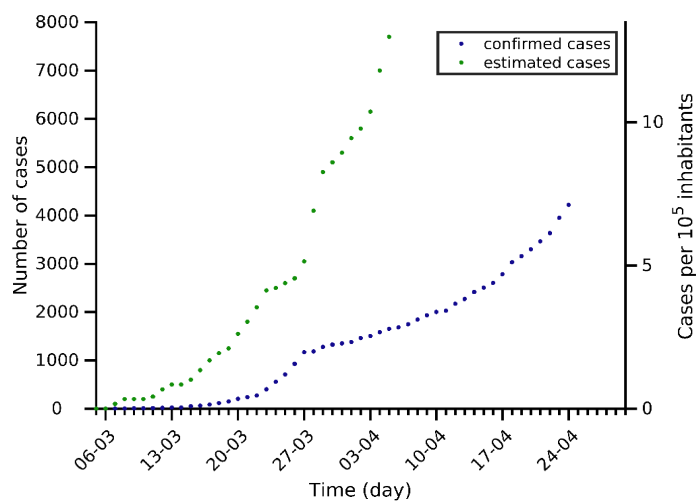
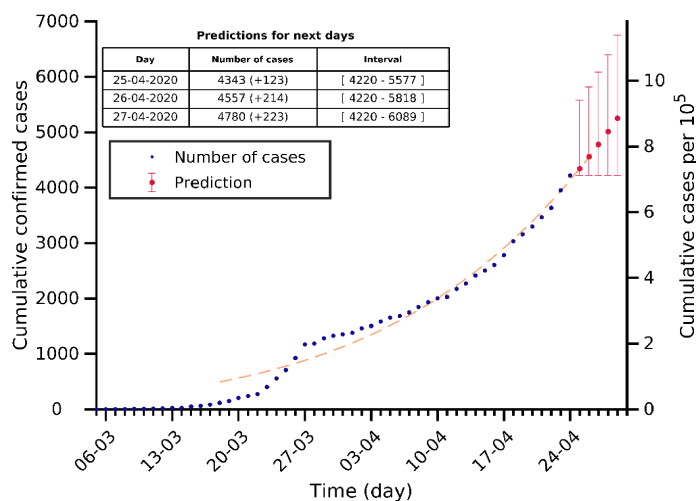
# Australia 24-04-2020. Population: 25.5M. Current cumulated incidence: 26/10<sup>5</sup>



# Malaysia 24-04-2020. Population: 32.4M. Current cumulated incidence: 18/10<sup>5</sup>



# South Africa 24-04-2020. Population: 59.3M. Current cumulated incidence: $7/10^5$

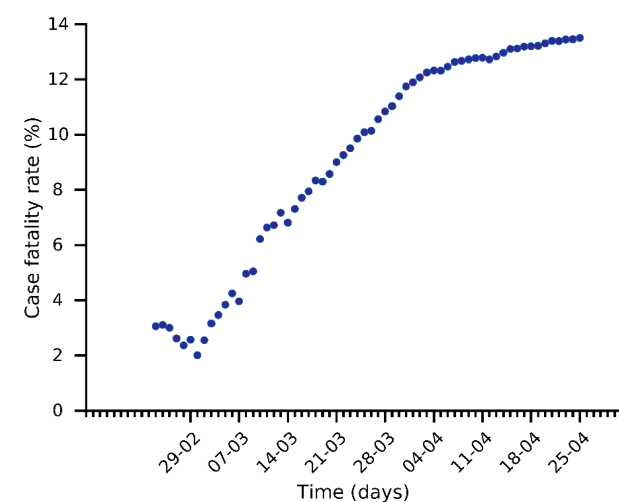
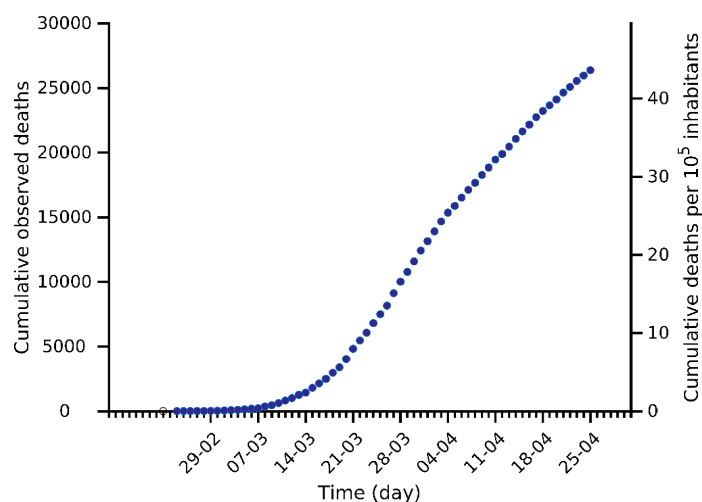
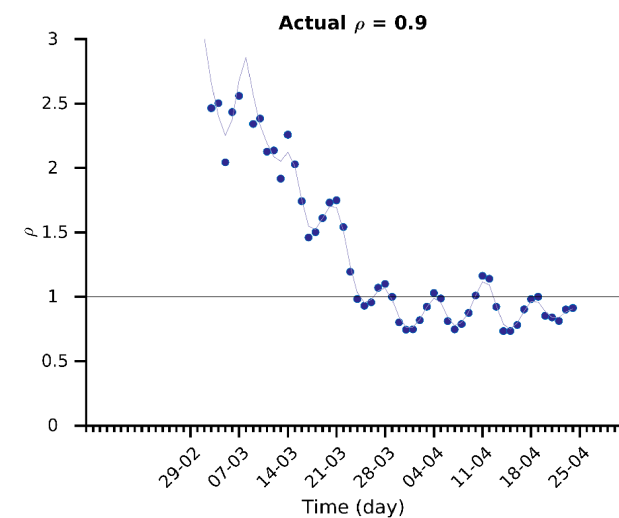
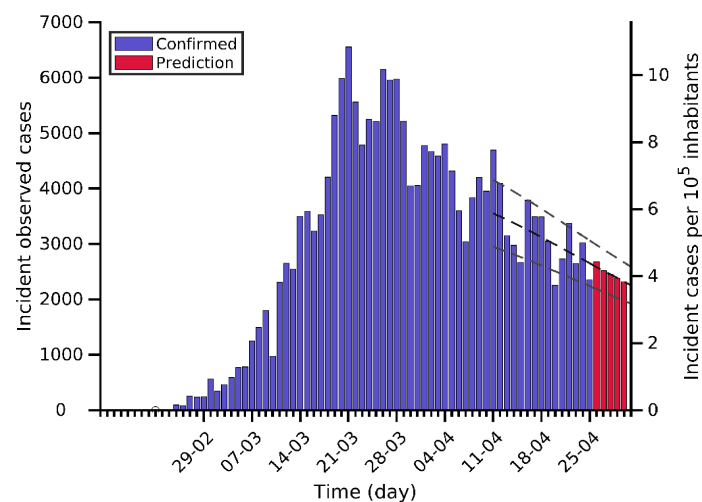
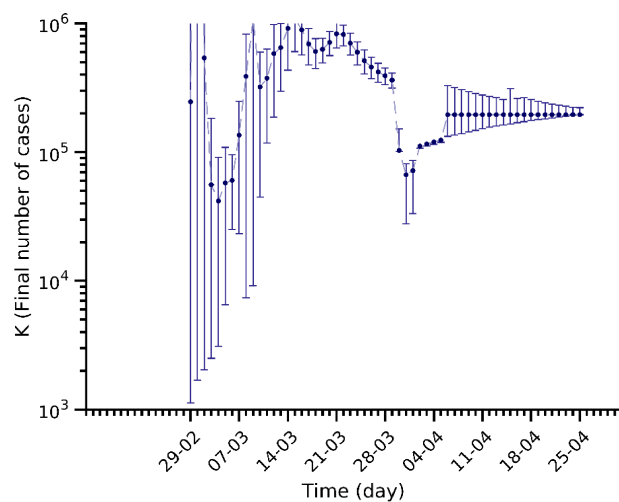
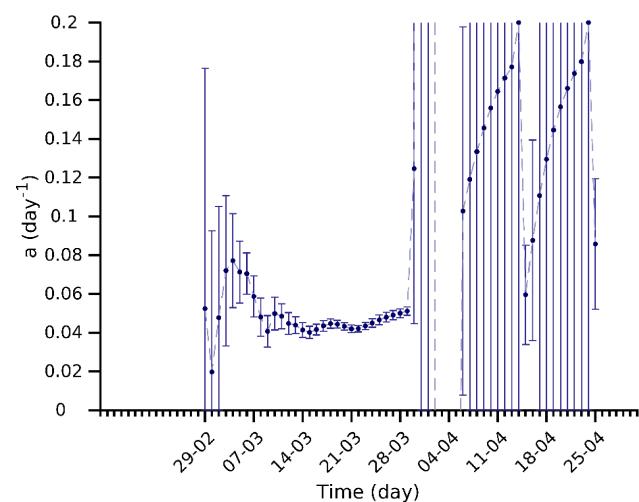
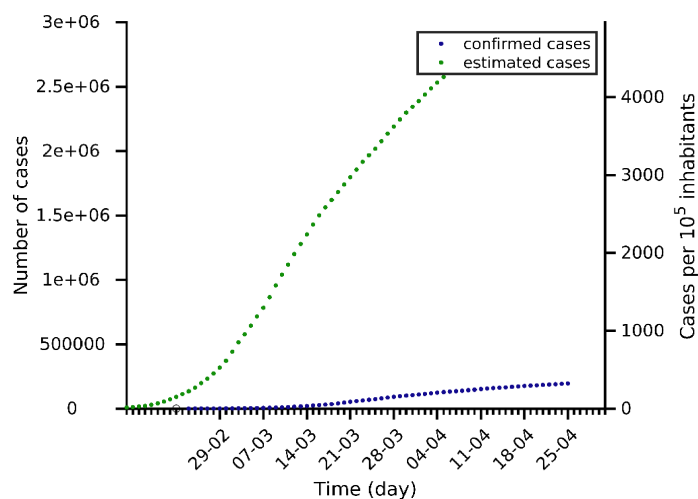
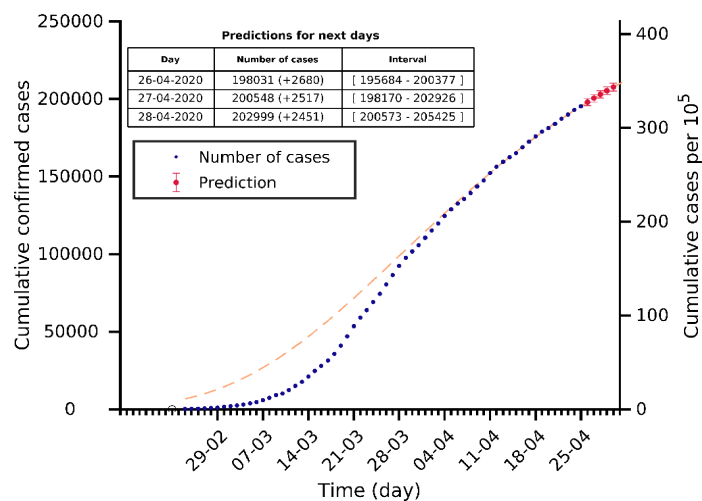


### **(3) Analysis and prediction of COVID-19 for Italy and its regions**

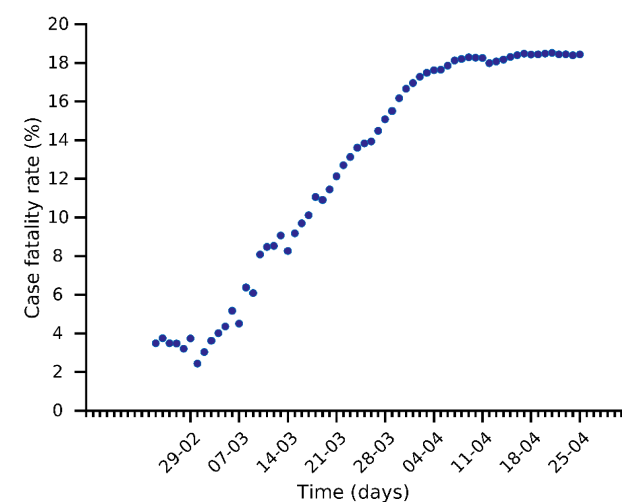
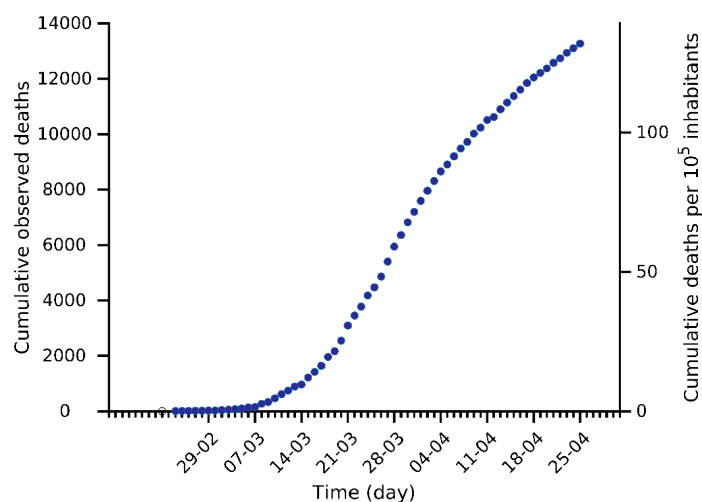
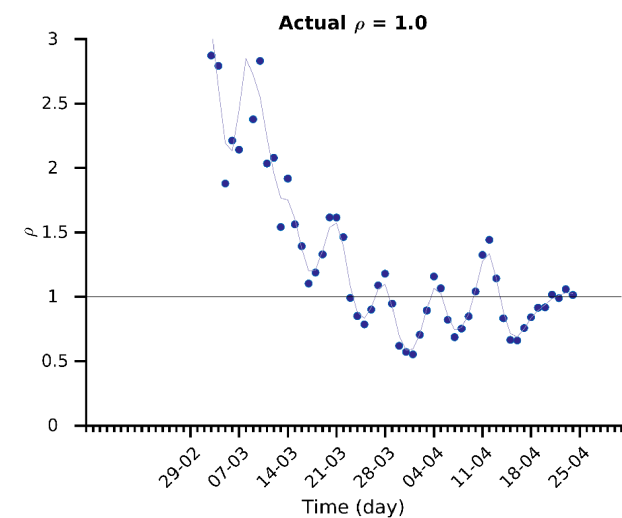
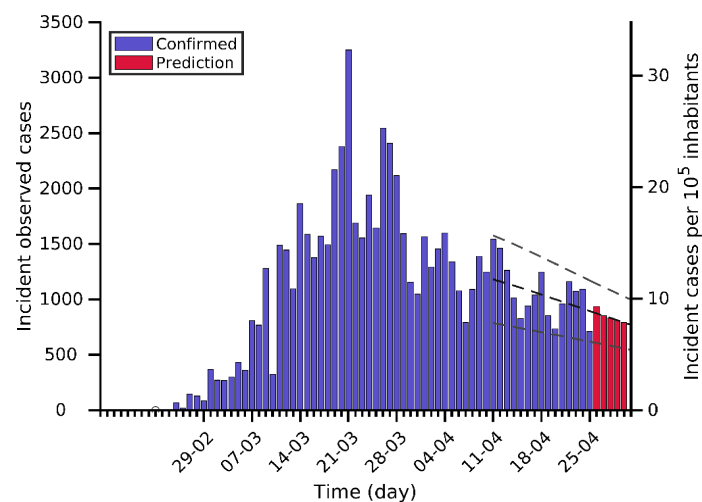
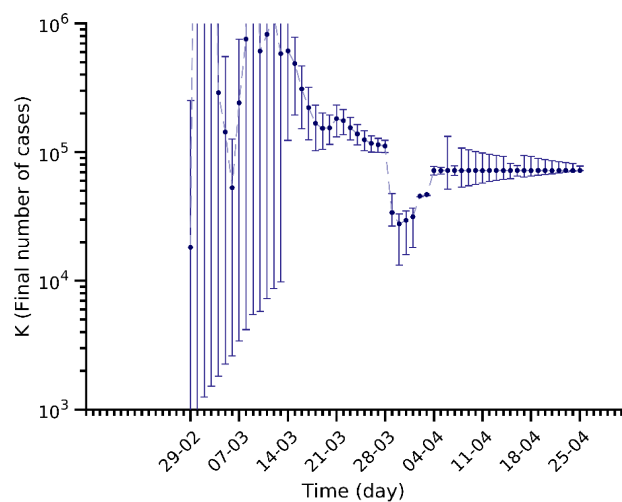
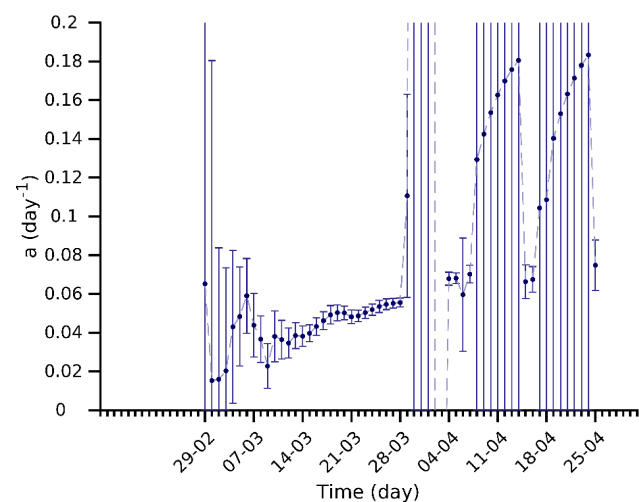
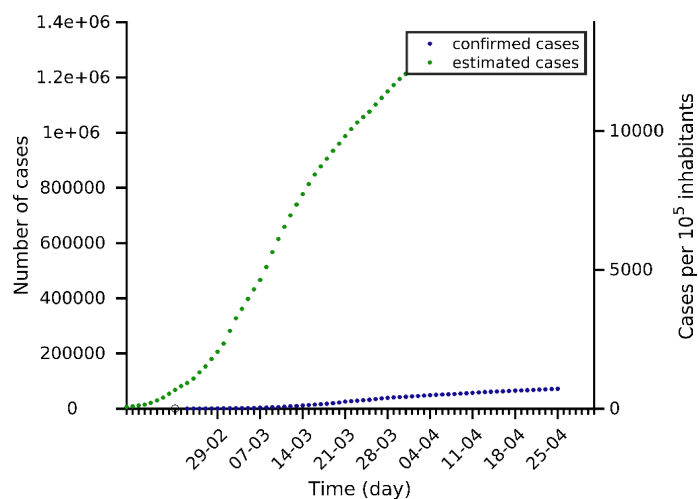
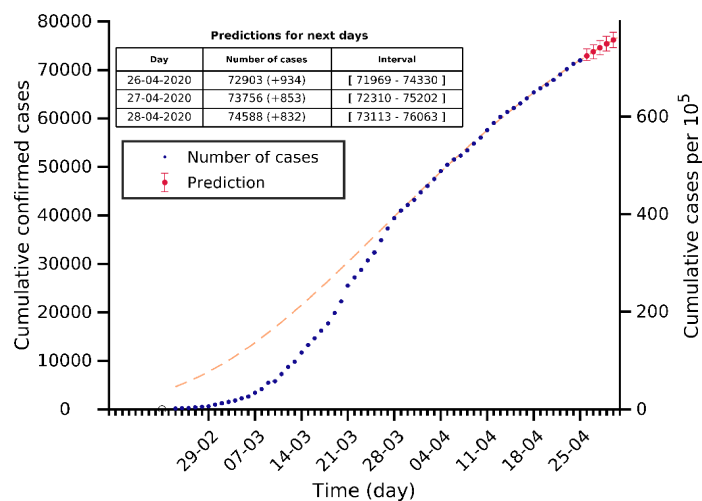
Data obtained from: <https://github.com/pcm-dpc/COVID-19/tree/master/dati-andamento-nazionale>



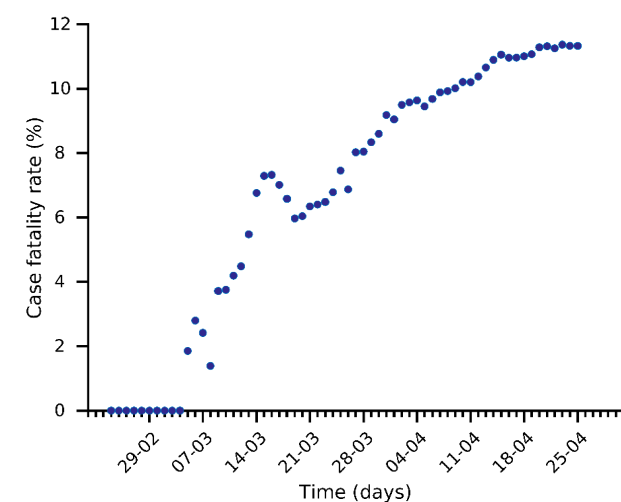
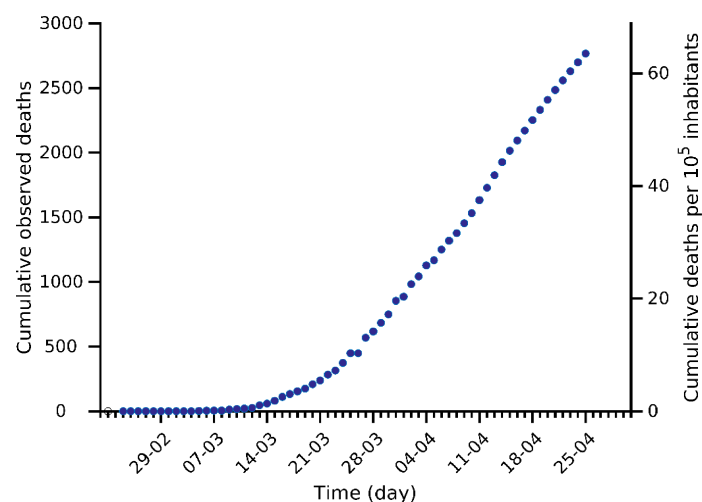
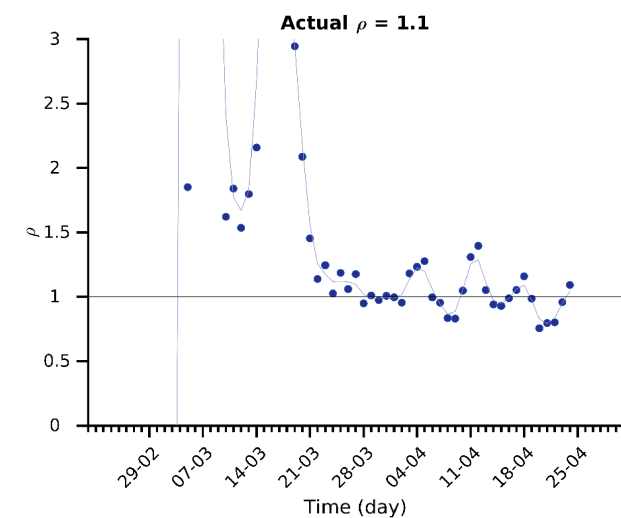
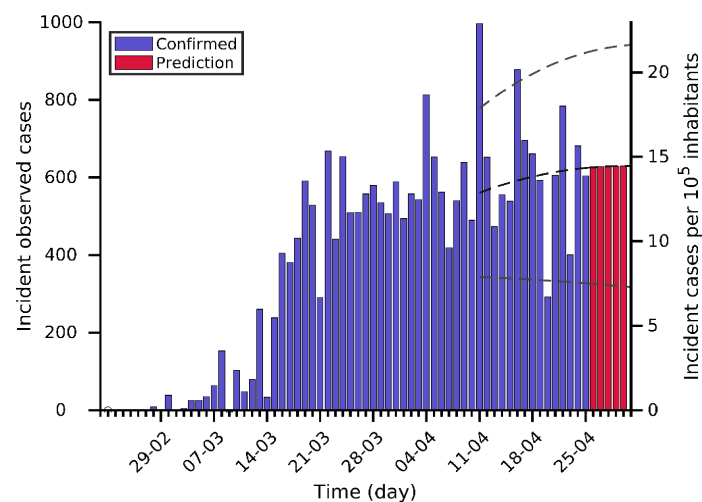
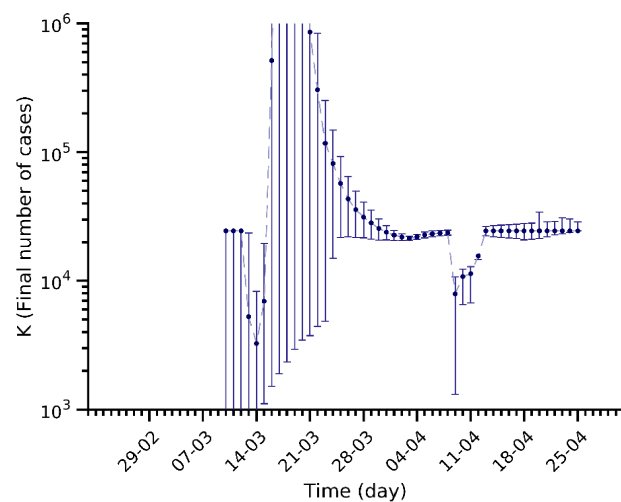
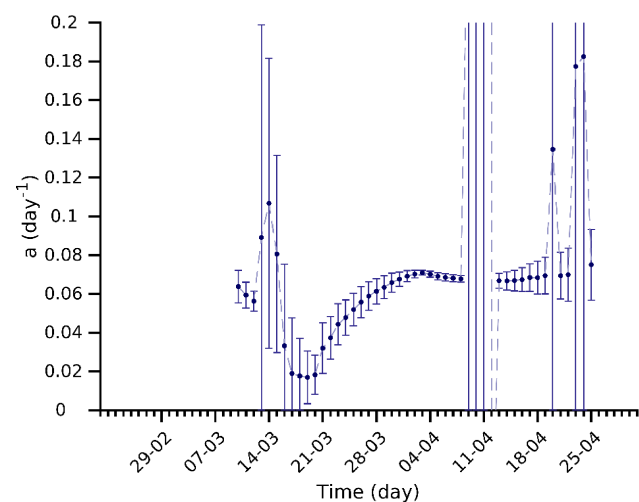
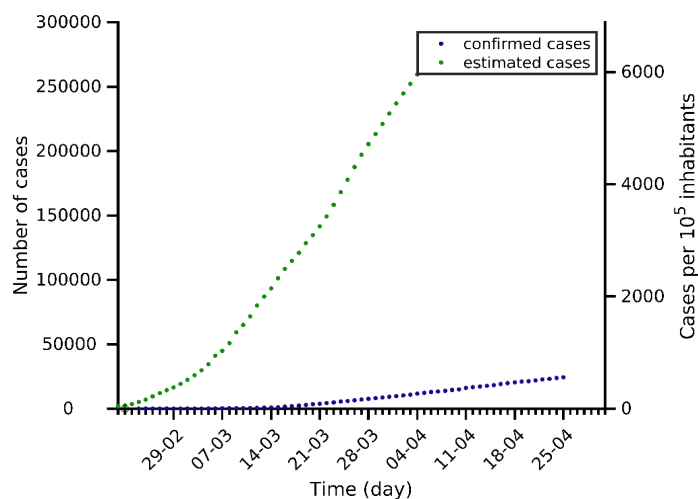
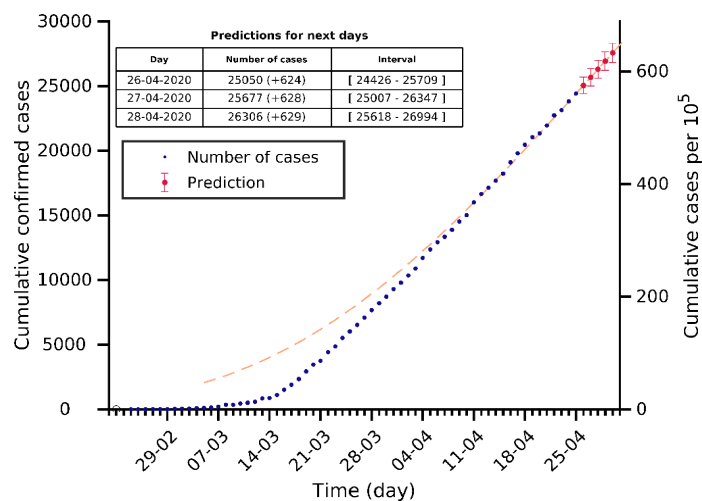
# Italy 25-04-2020. Population: 60.5M. Current cumulated incidence: 323/10<sup>5</sup>



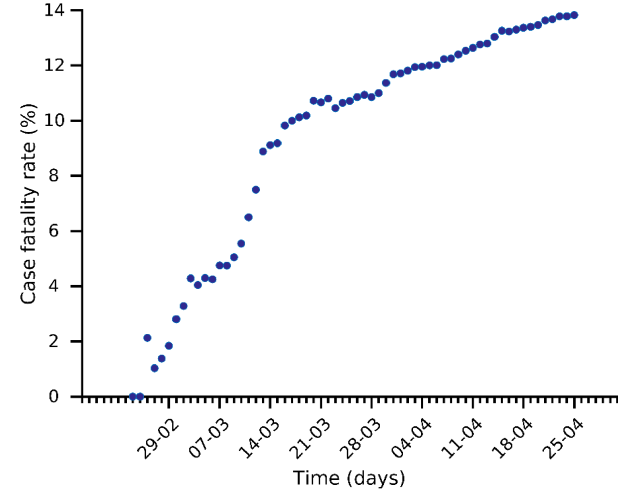
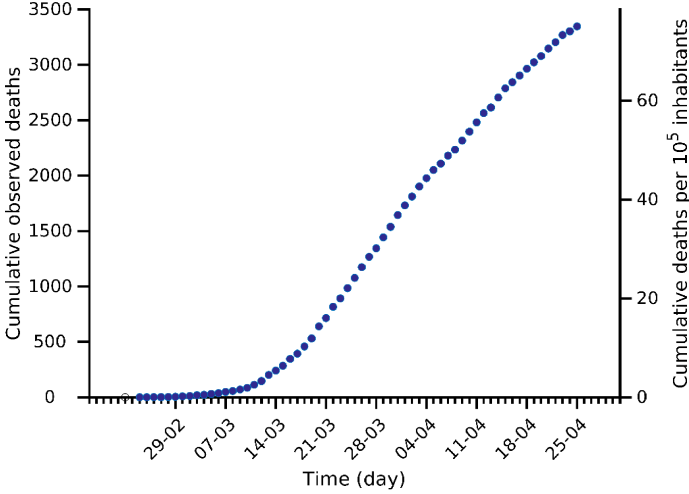
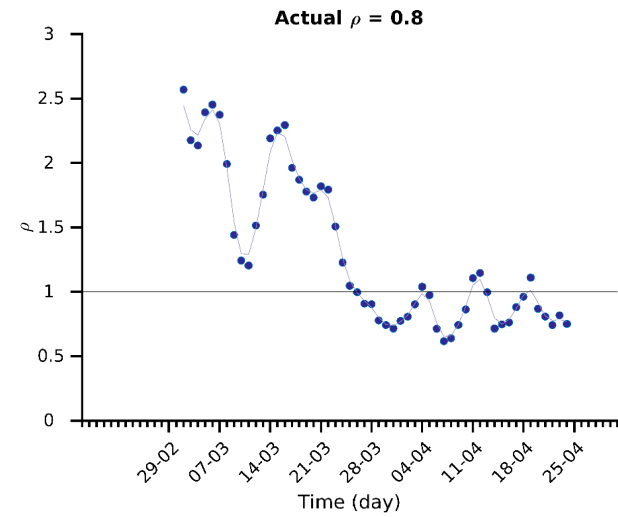
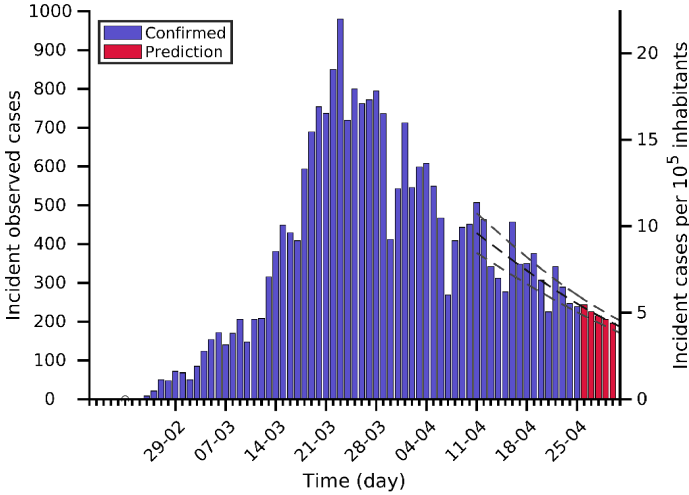
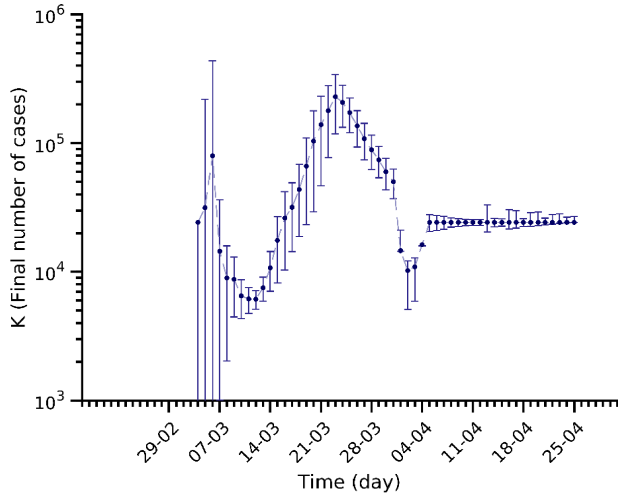
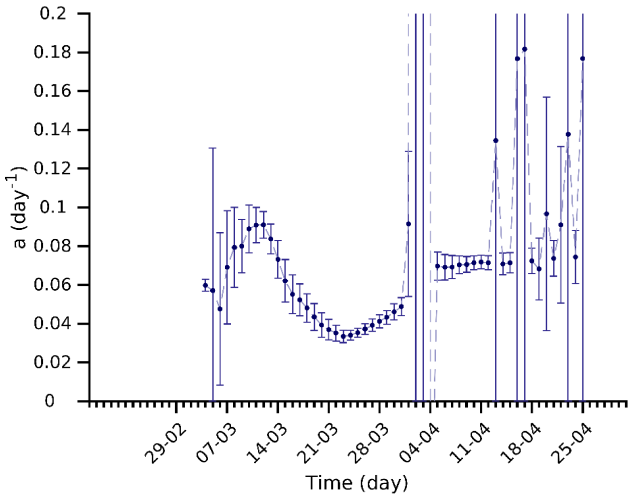
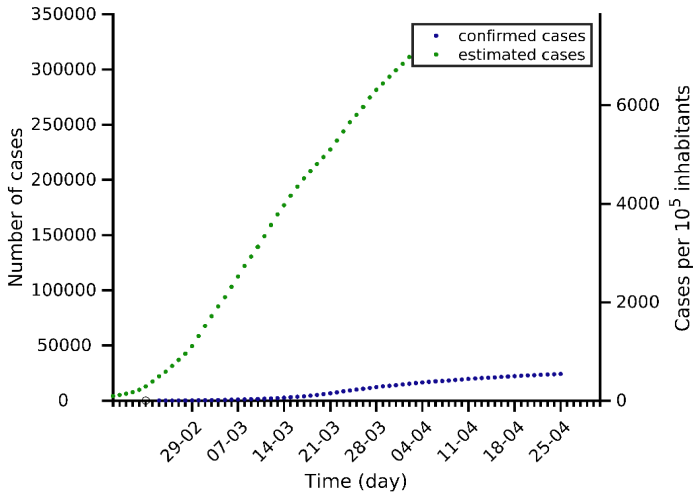
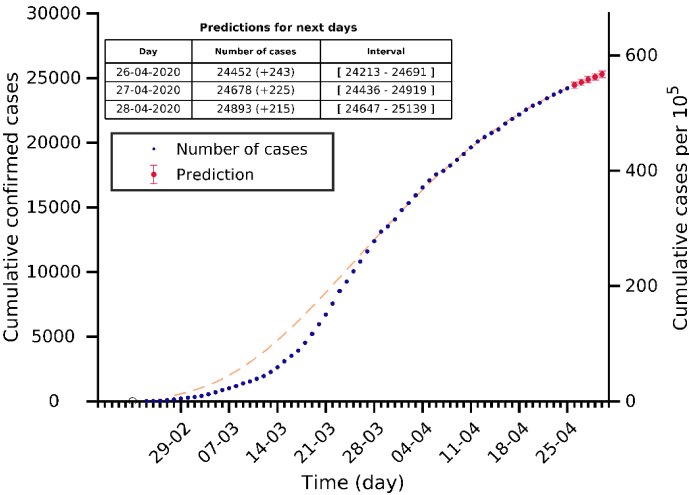
# Lombardia 25-04-2020. Population: 10.1M. Current cumulated incidence: 715/10<sup>5</sup>



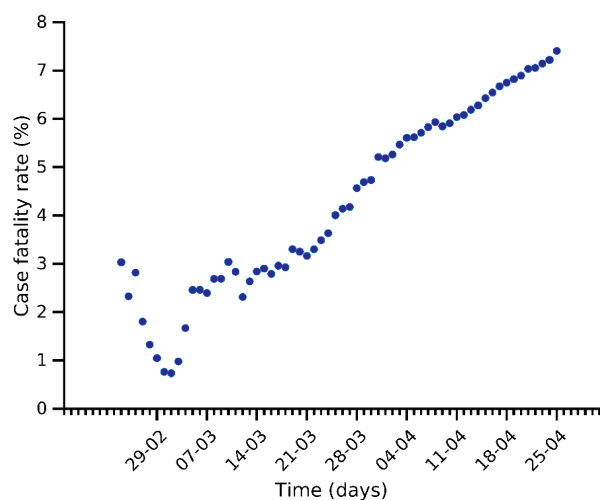
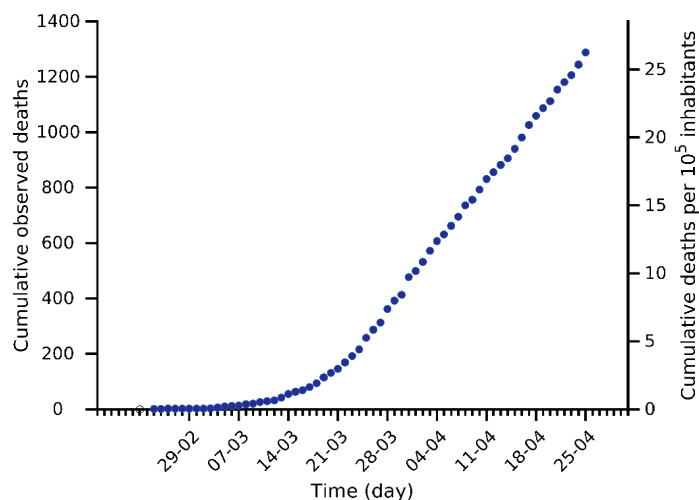
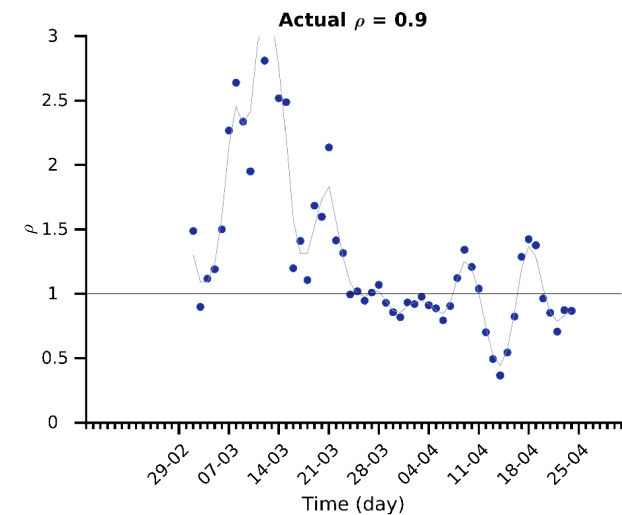
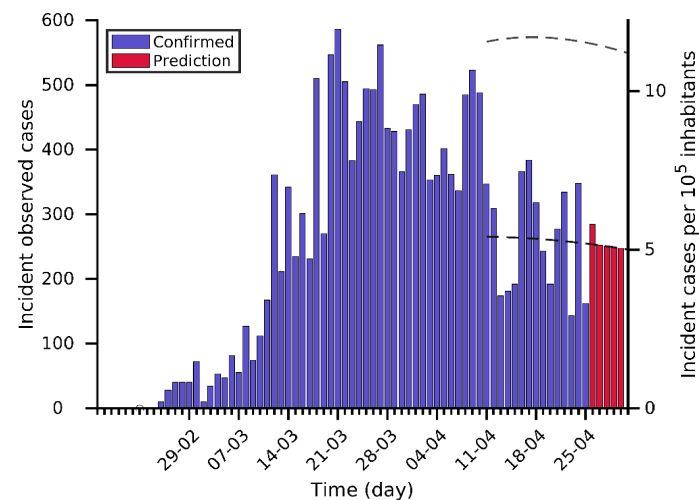
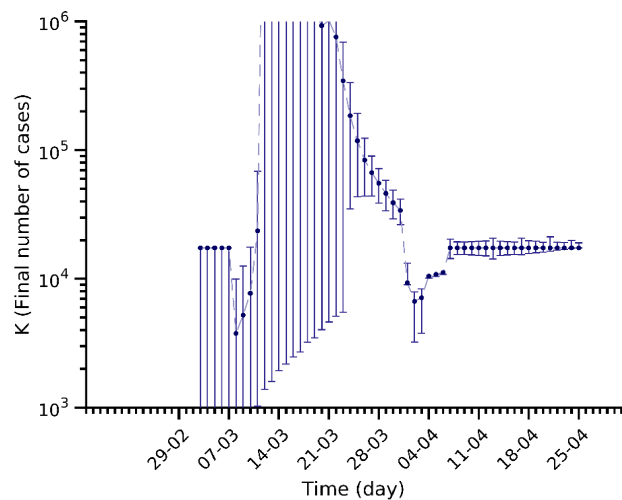
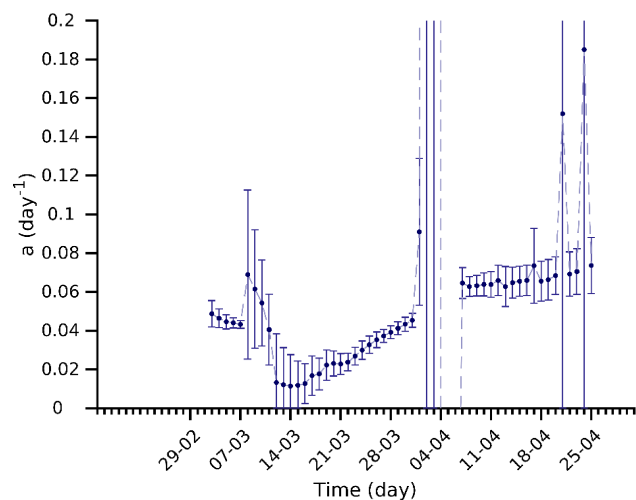
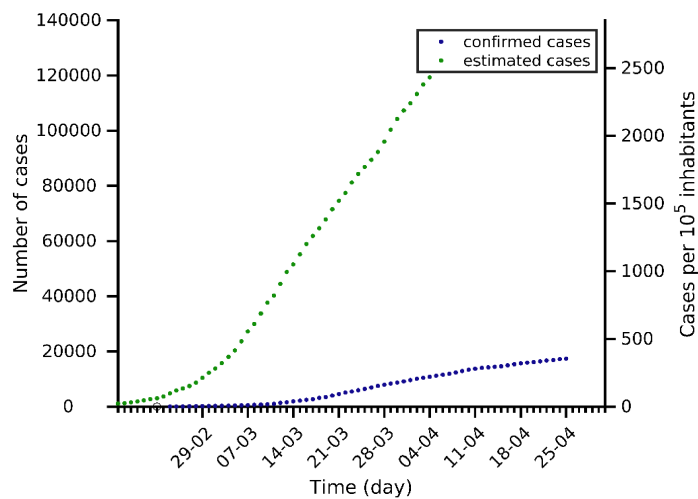
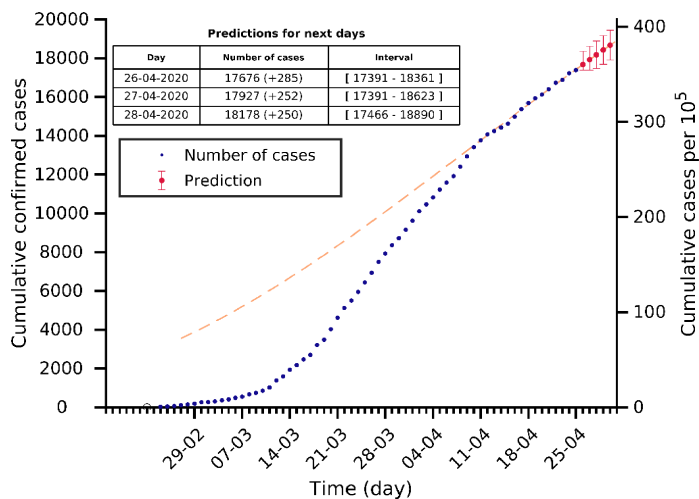
# Piemonte 25-04-2020. Population: 4.4M. Current cumulated incidence: 561/10<sup>5</sup>



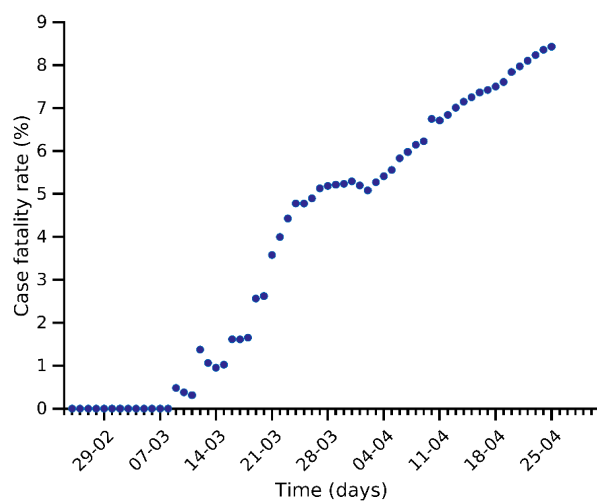
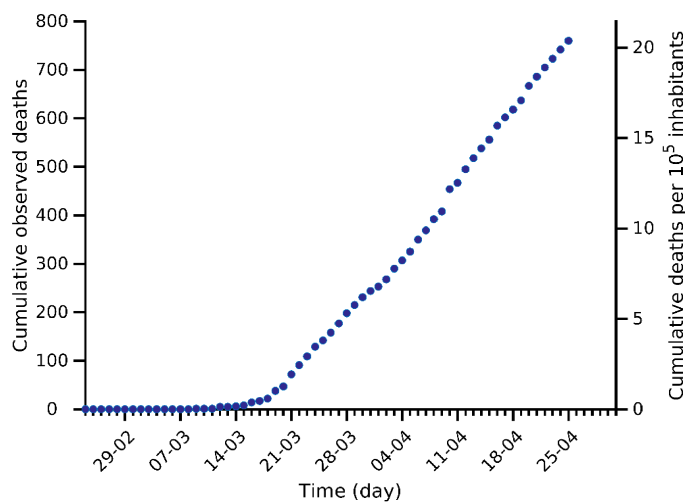
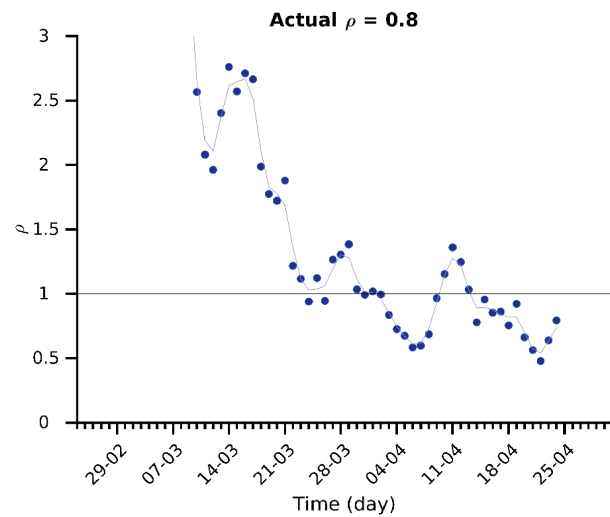
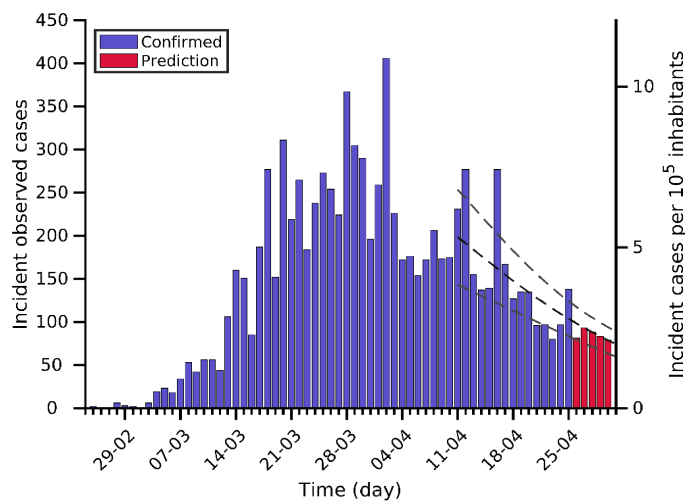
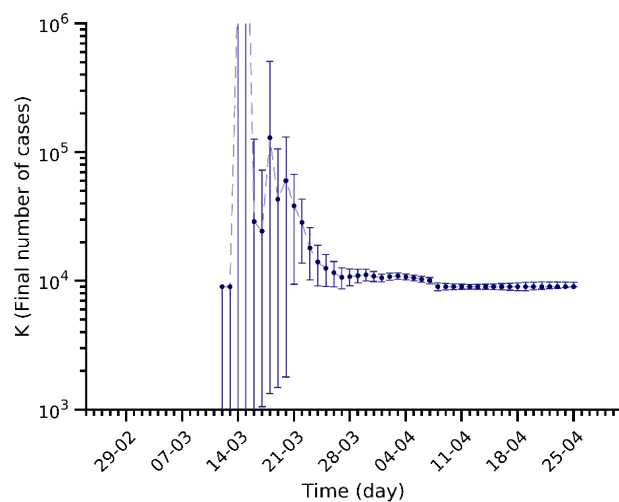
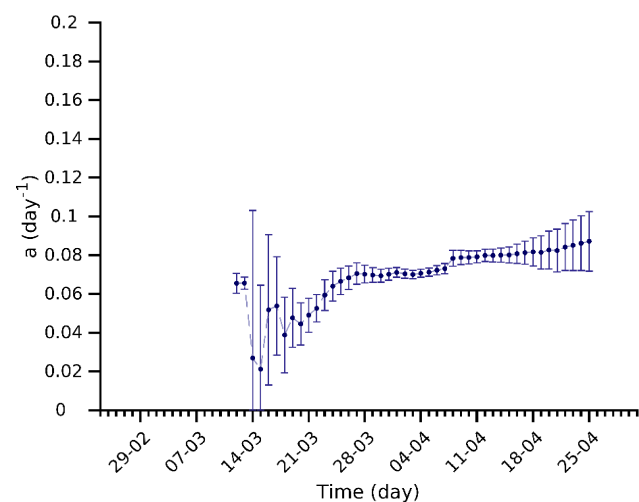
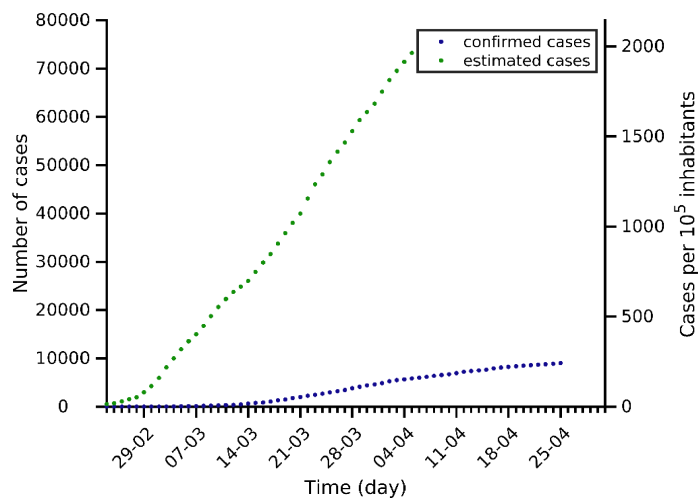
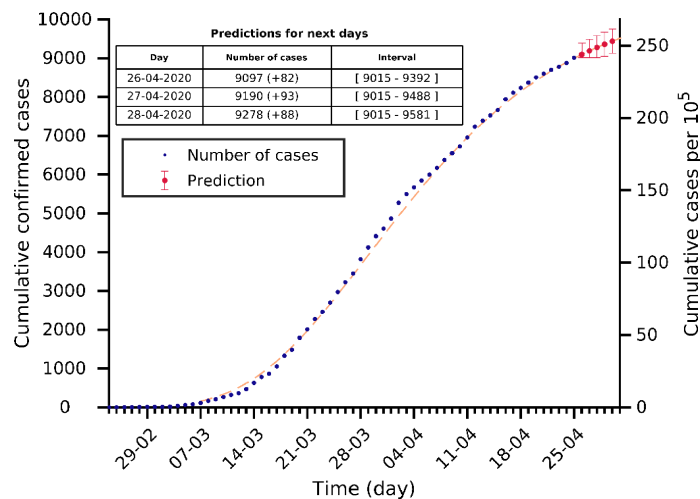
Emilia Romagna 25-04-2020. Population: 4.5M. Current cumulated incidence: 543/100,000



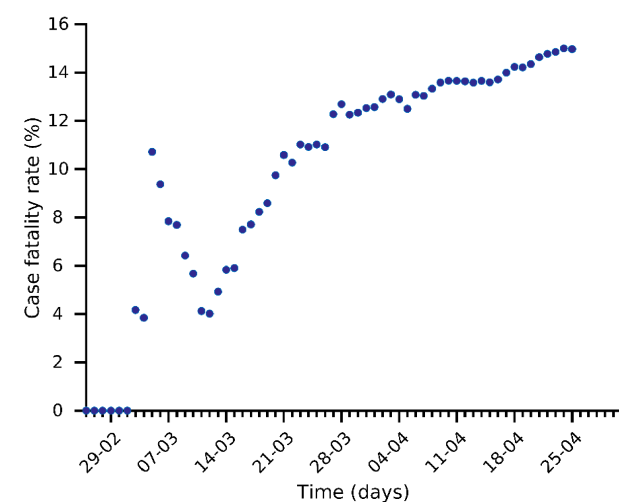
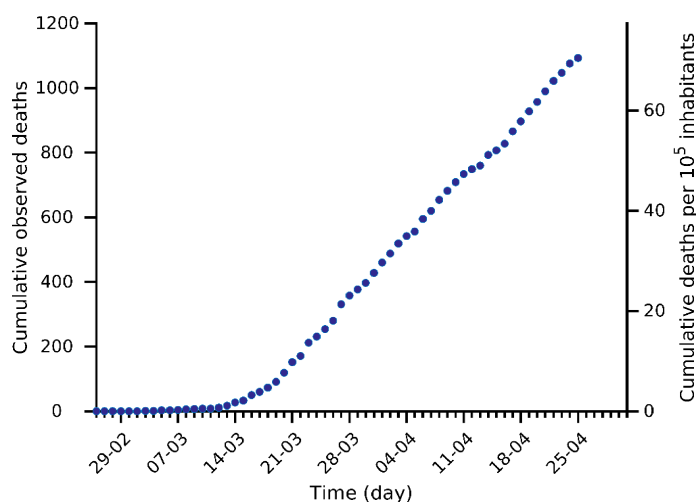
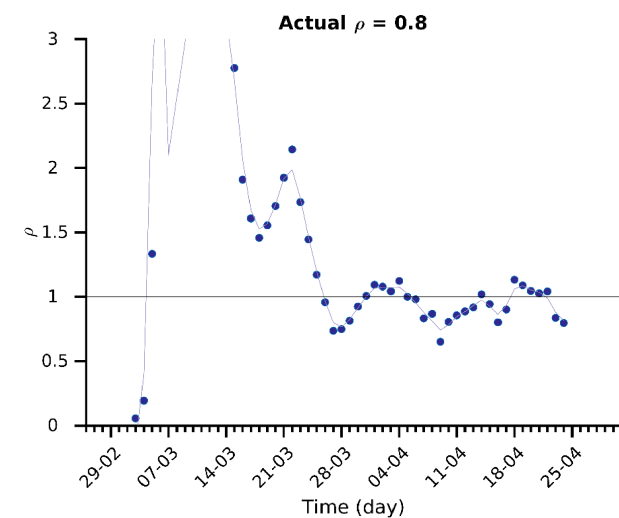
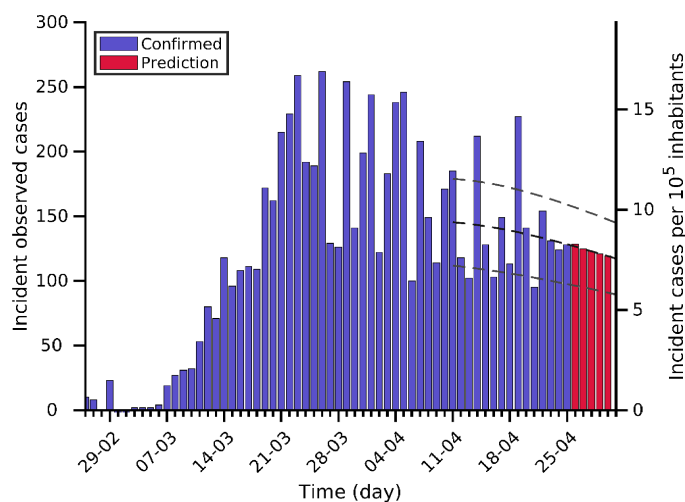
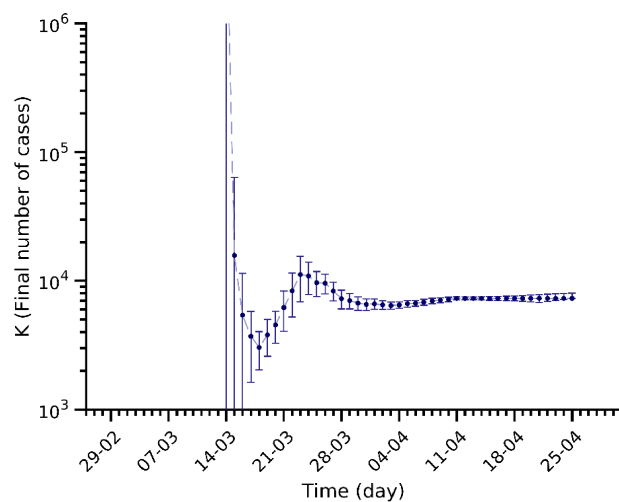
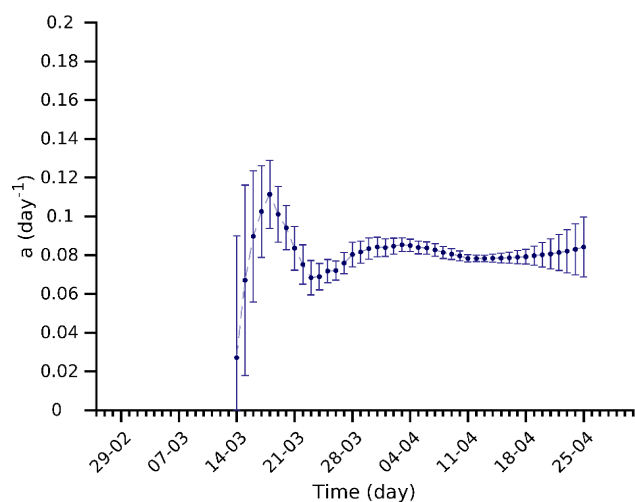
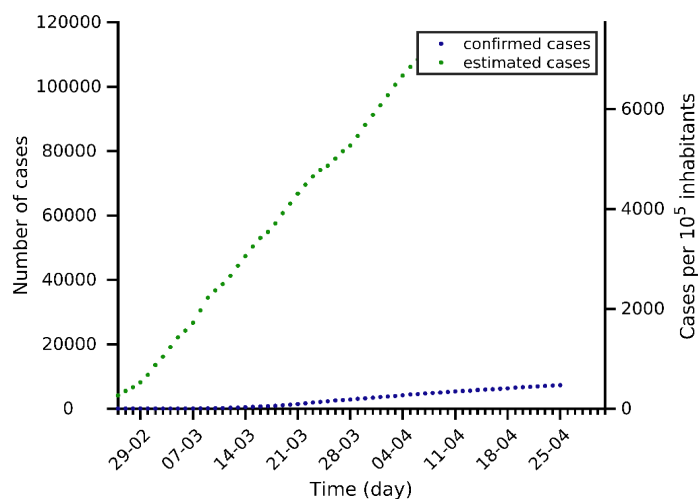
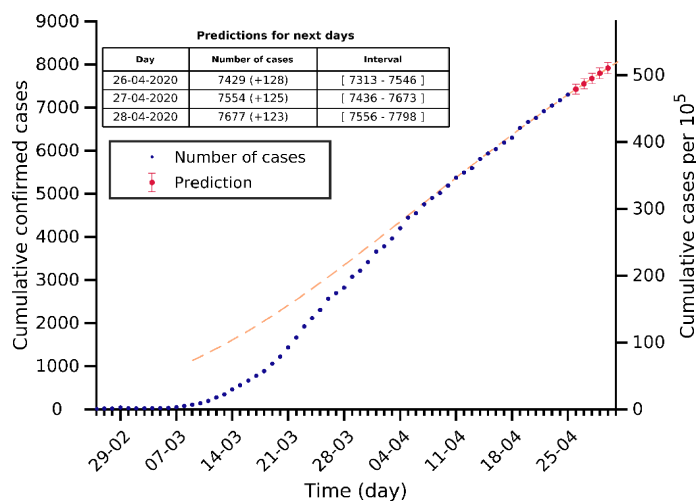
# Veneto 25-04-2020. Population: 4.9M. Current cumulated incidence: 354/10<sup>5</sup>



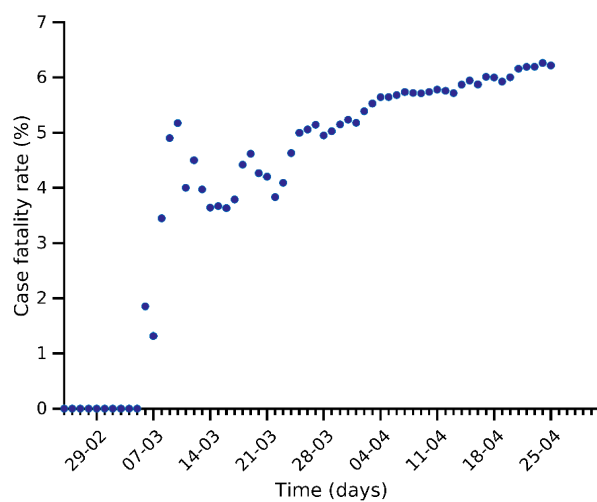
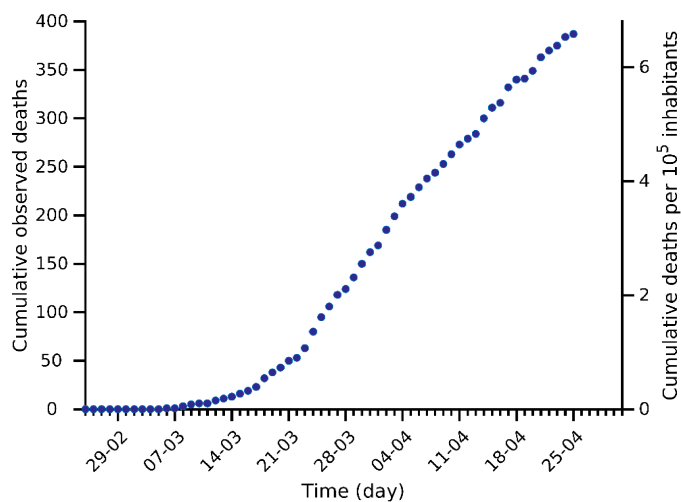
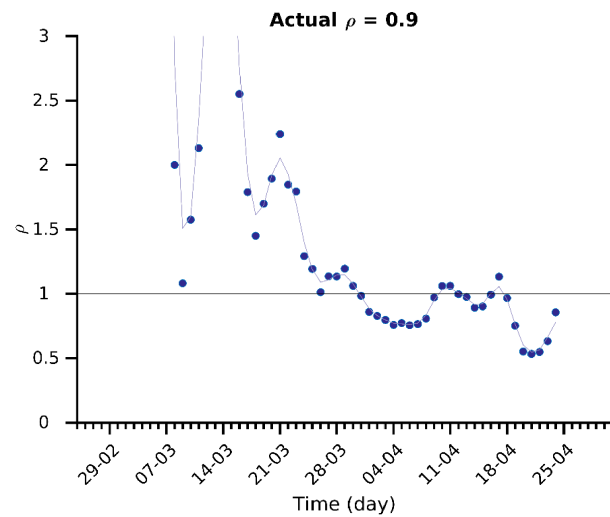
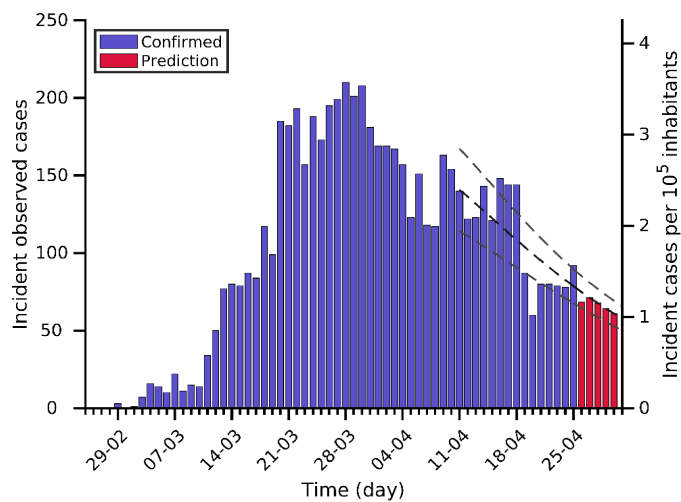
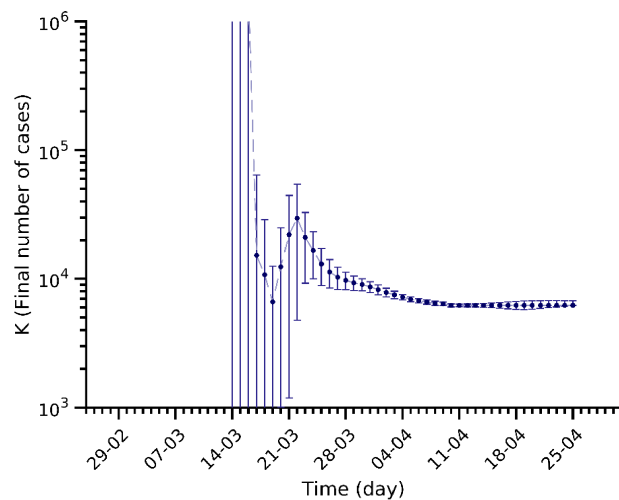
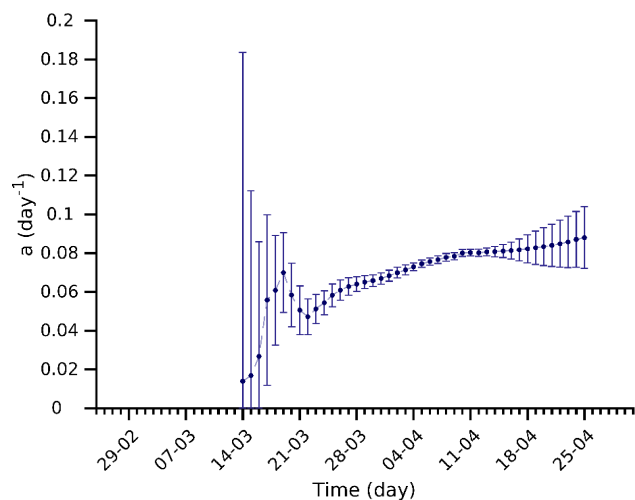
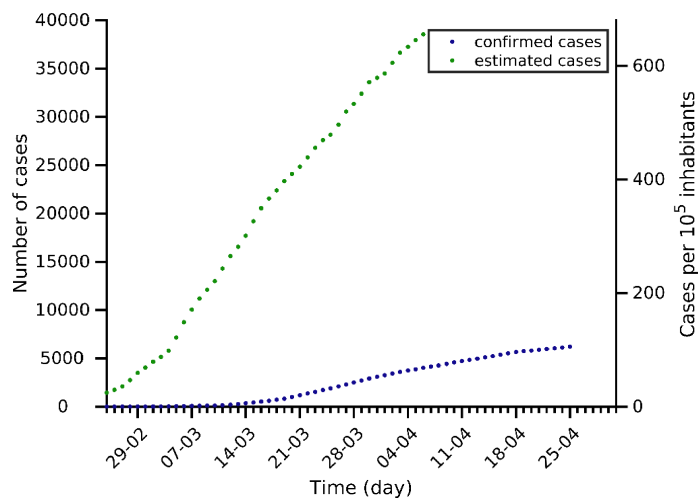
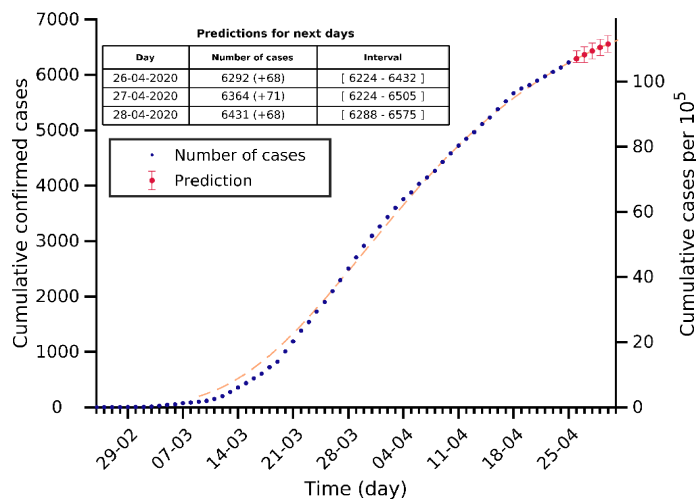
# Toscana 25-04-2020. Population: 3.7M. Current cumulated incidence: 242/10<sup>5</sup>



# Liguria 25-04-2020. Population: 1.6M. Current cumulated incidence: 471/10<sup>5</sup>

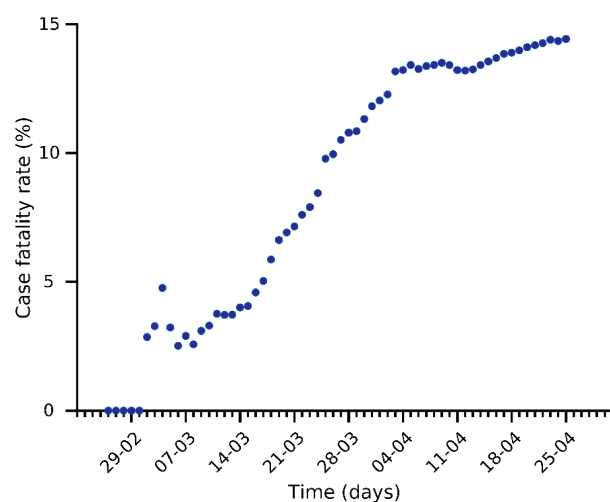
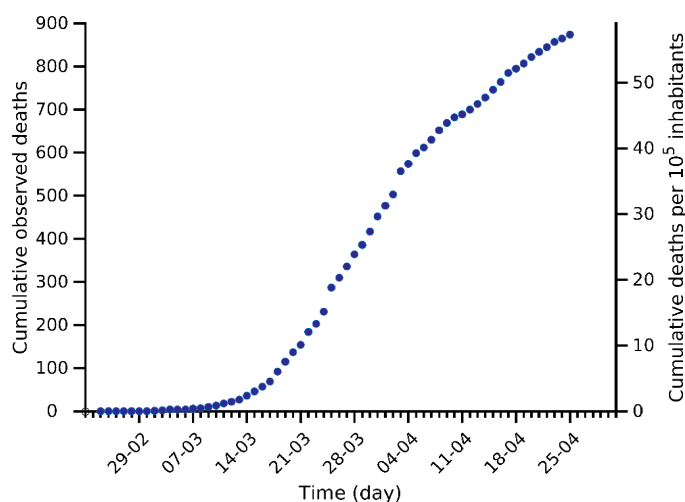
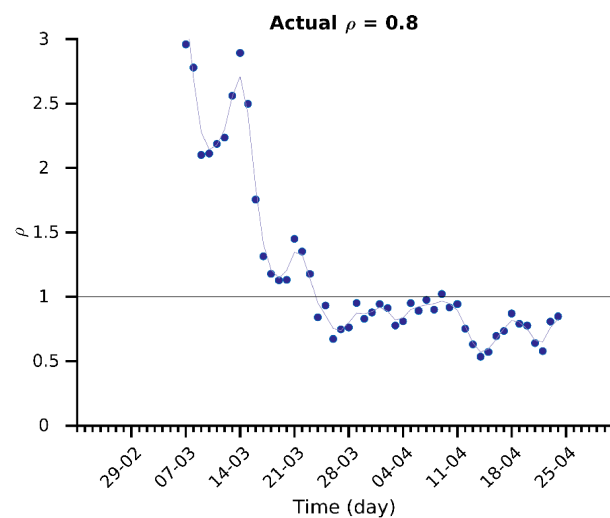
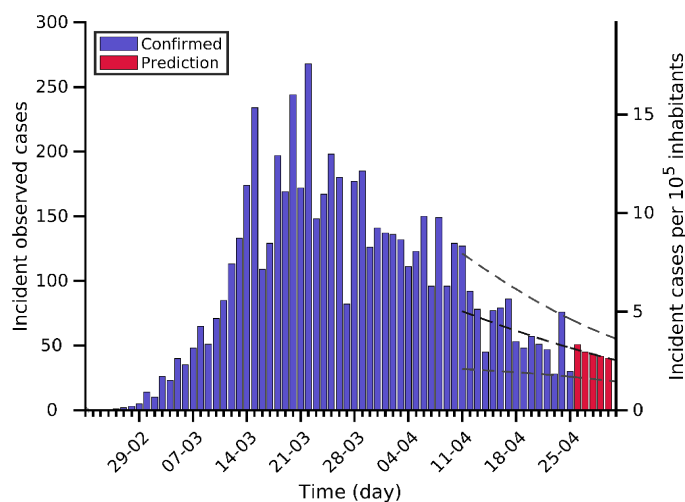
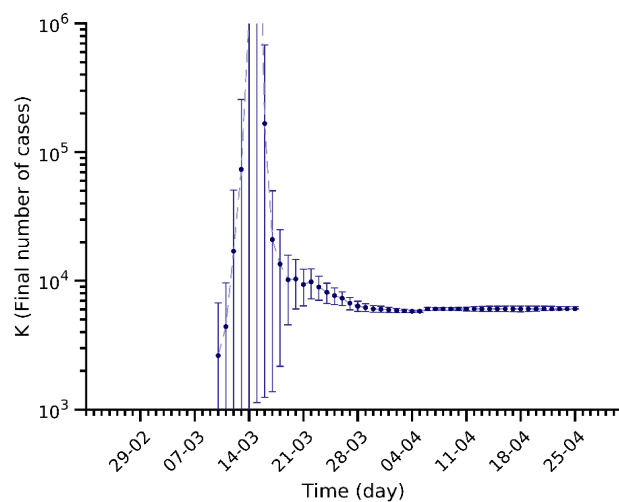
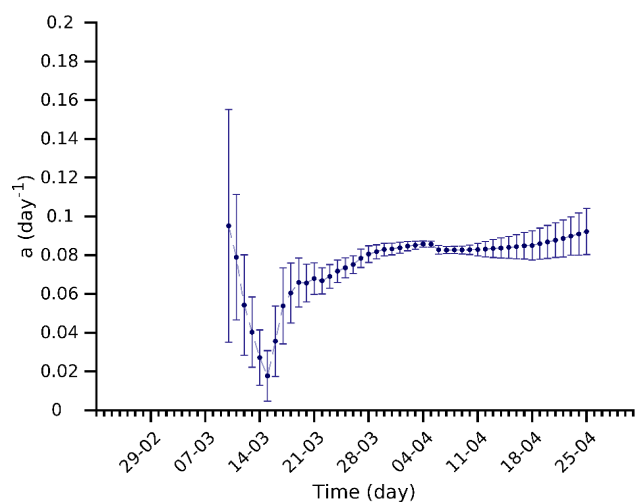
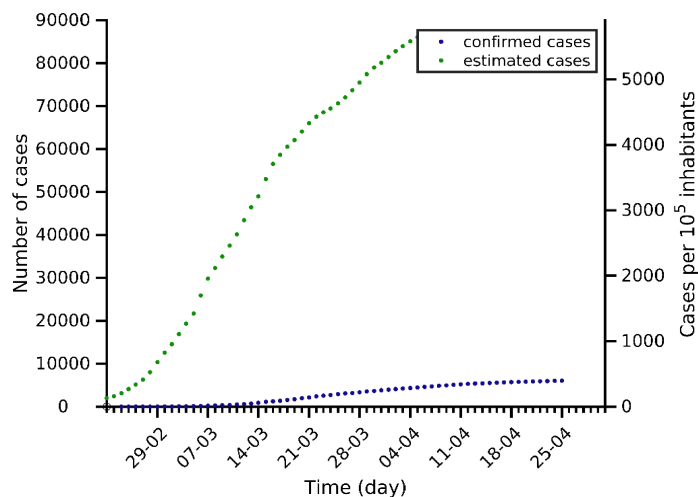
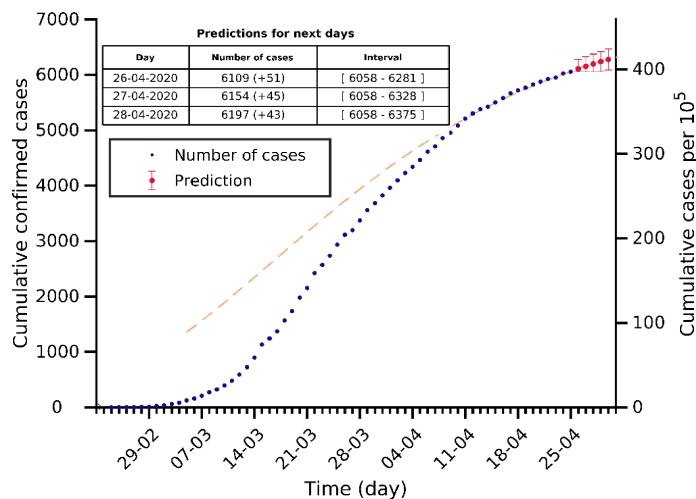


# Lazio 25-04-2020. Population: 5.9M. Current cumulated incidence: 106/10<sup>5</sup>

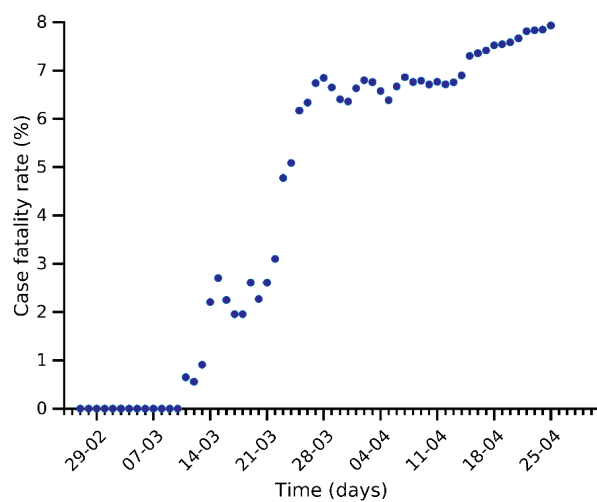
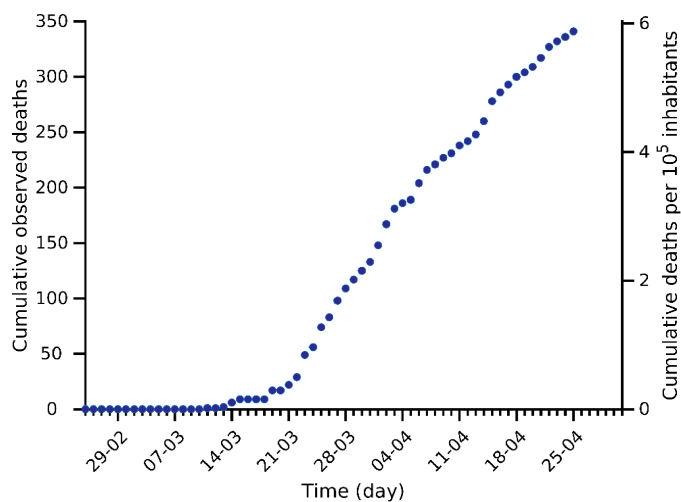
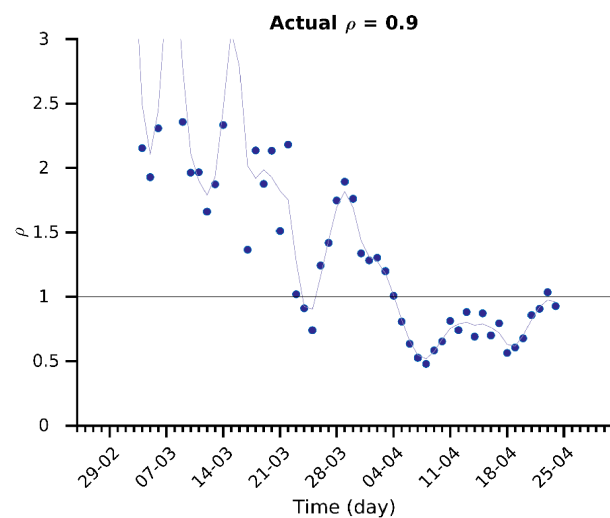
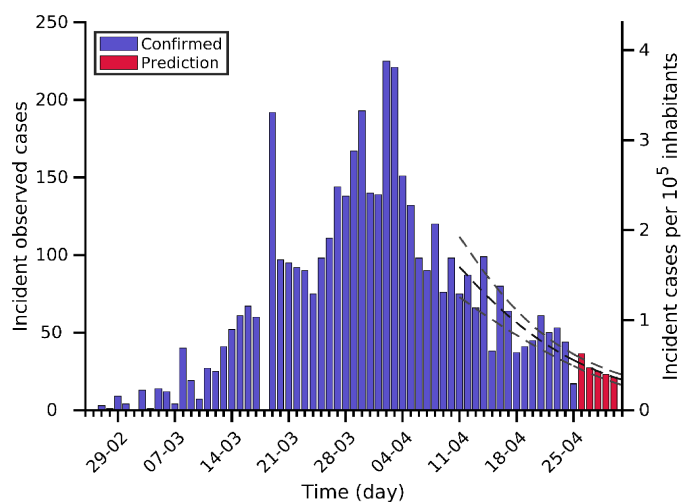
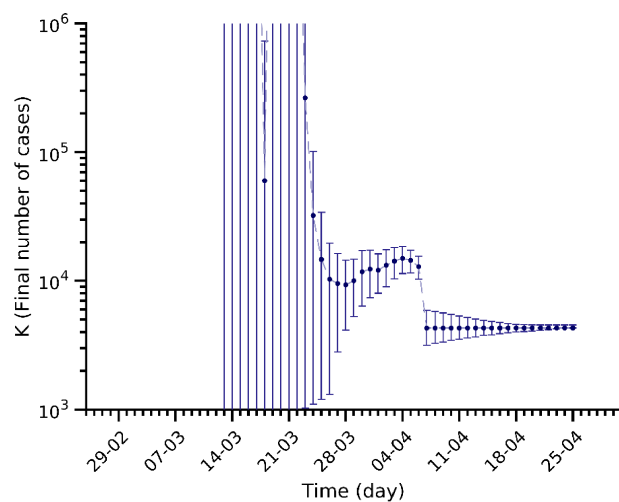
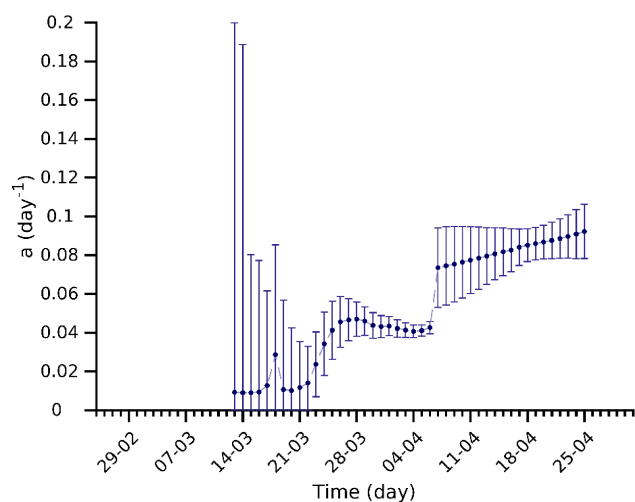
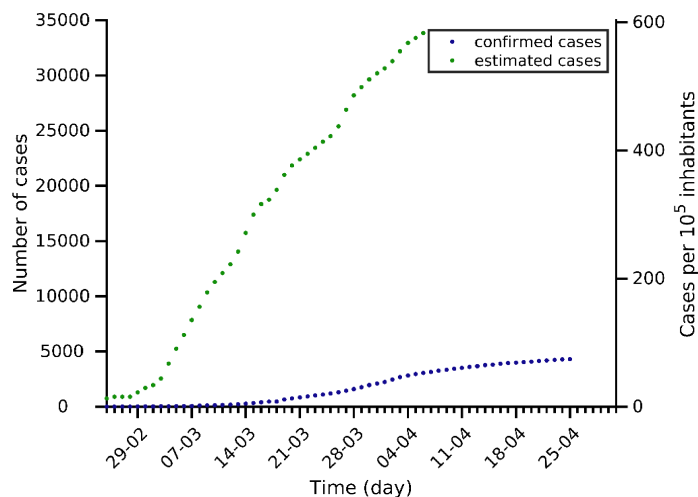
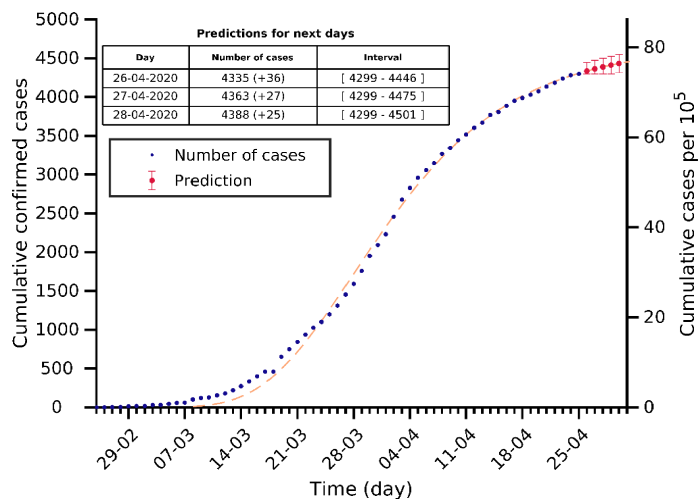




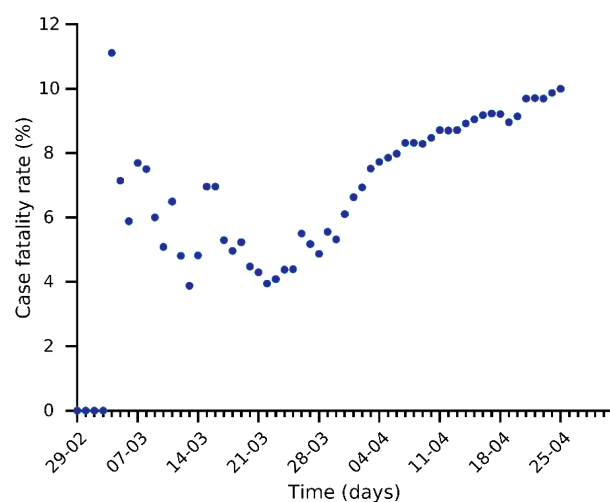
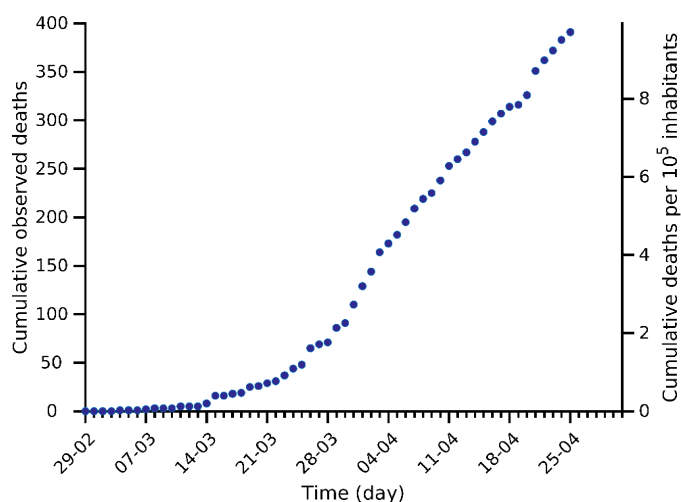
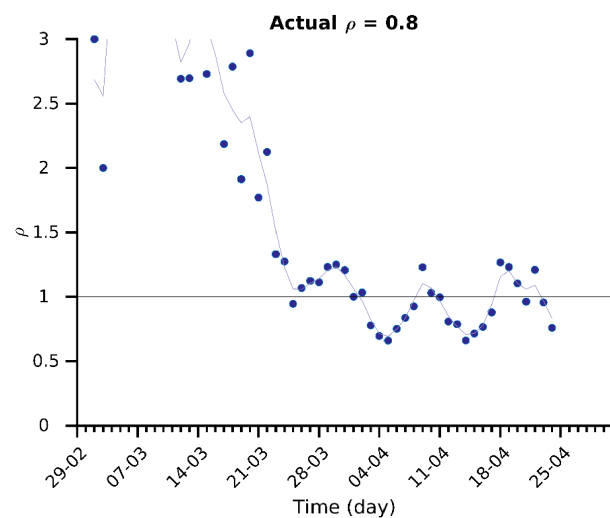
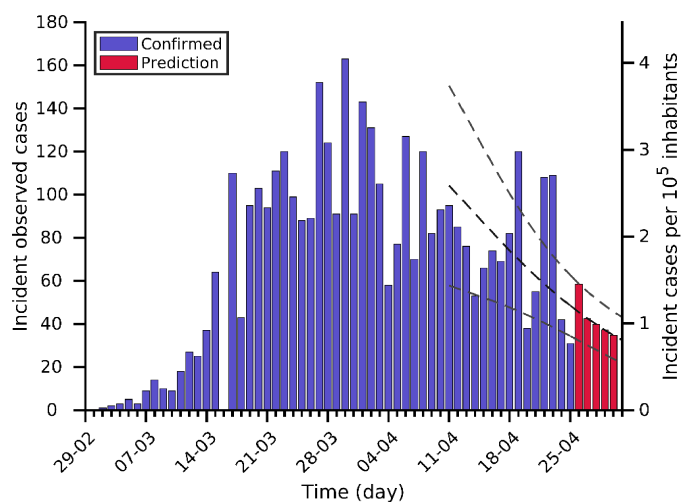
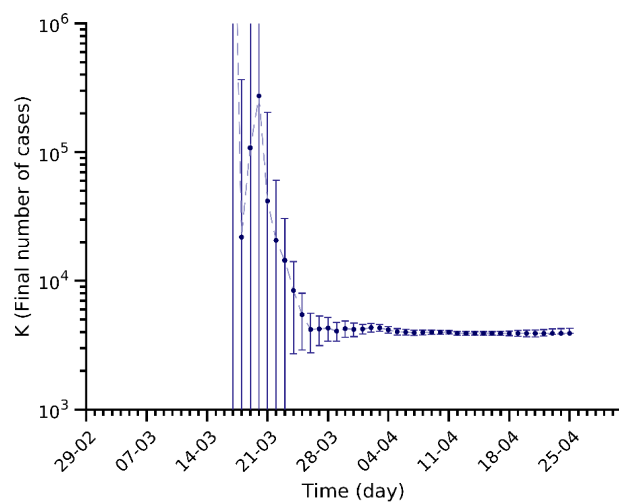
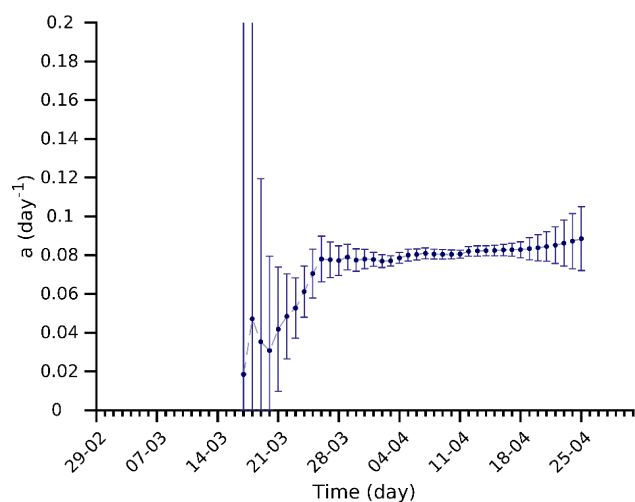
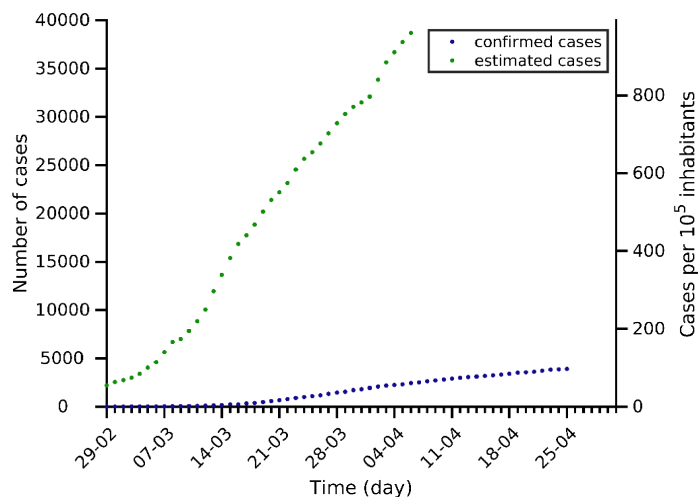
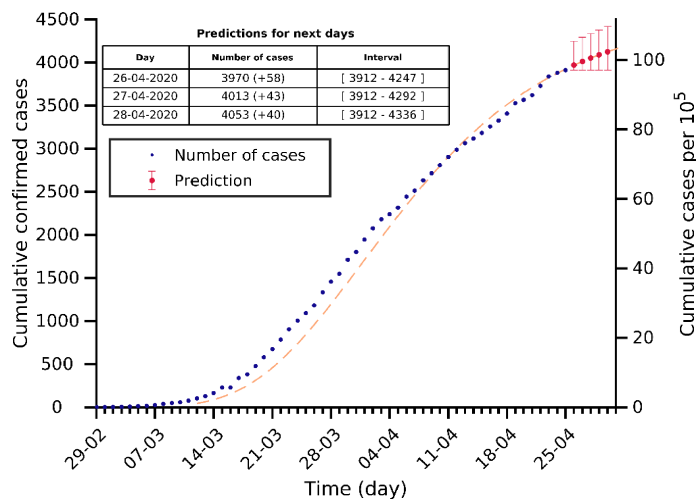
# **Marche 25-04-2020. Population: 1.5M. Current cumulated incidence: 397/10<sup>5</sup>**



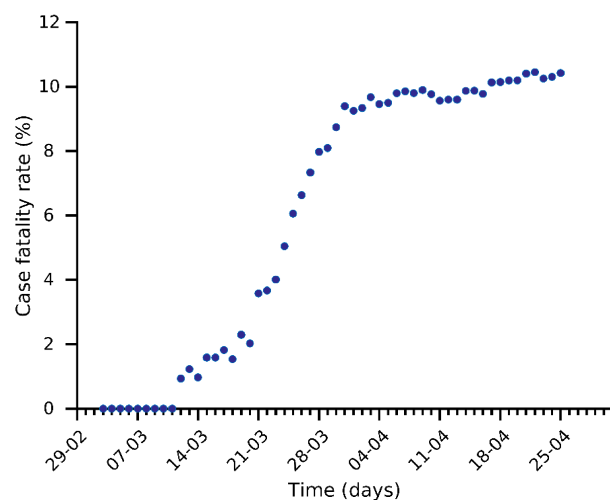
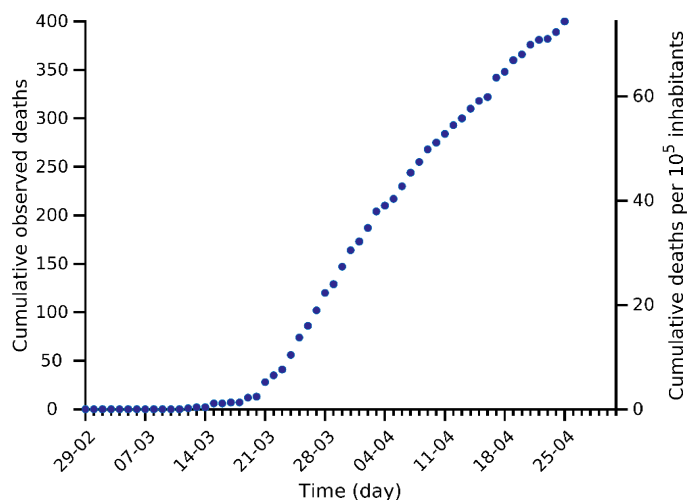
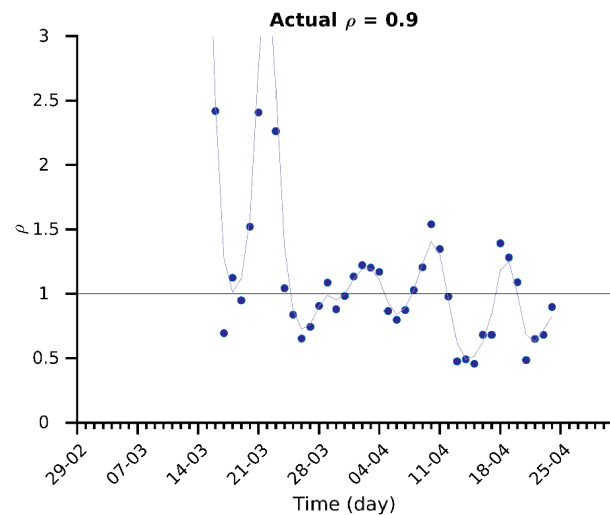
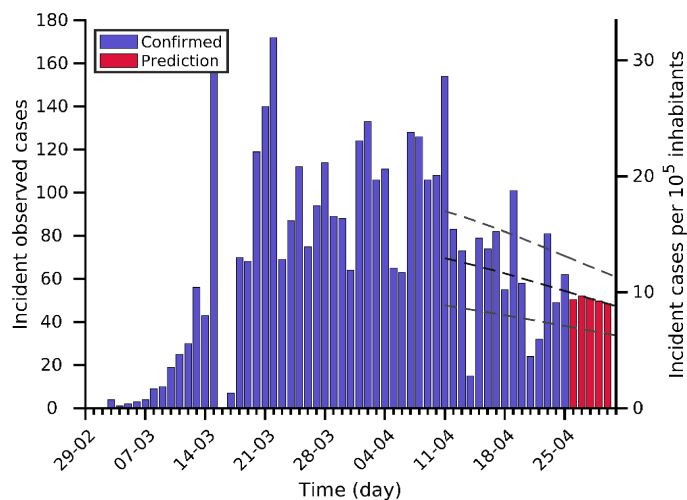
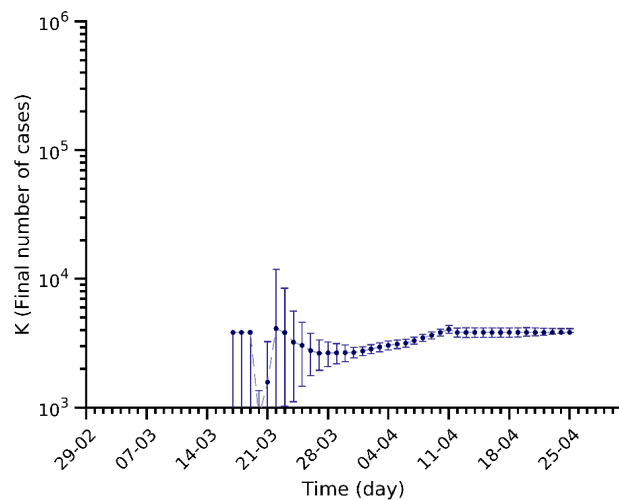
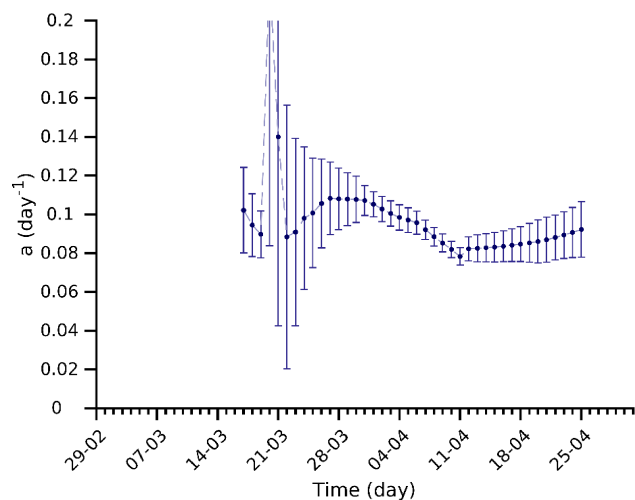
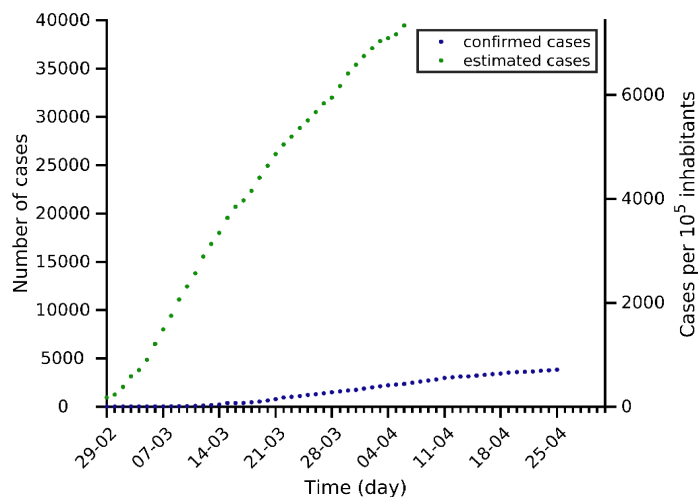
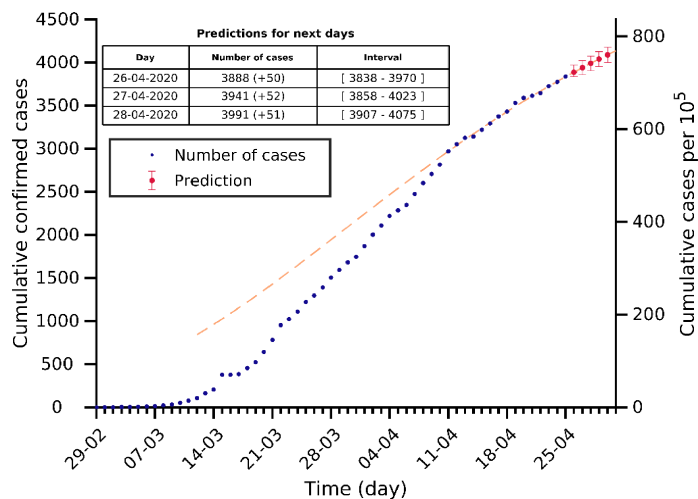
# Campania 25-04-2020. Population: 5.8M. Current cumulated incidence: 74/10<sup>5</sup>



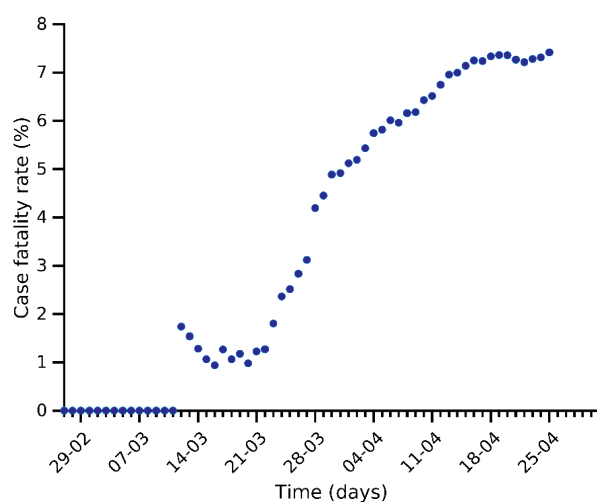
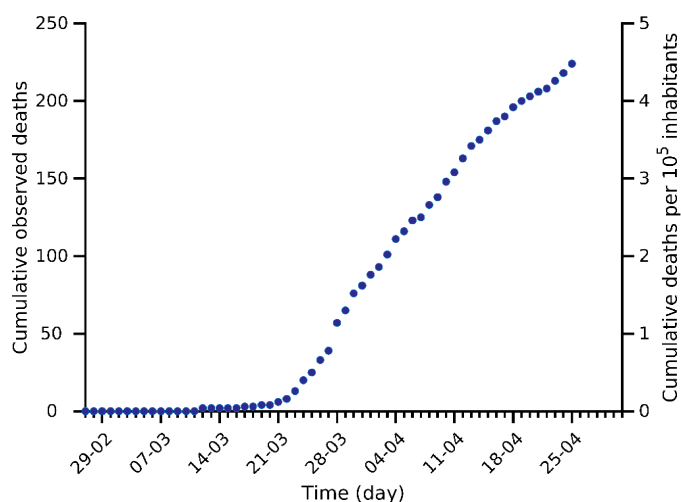
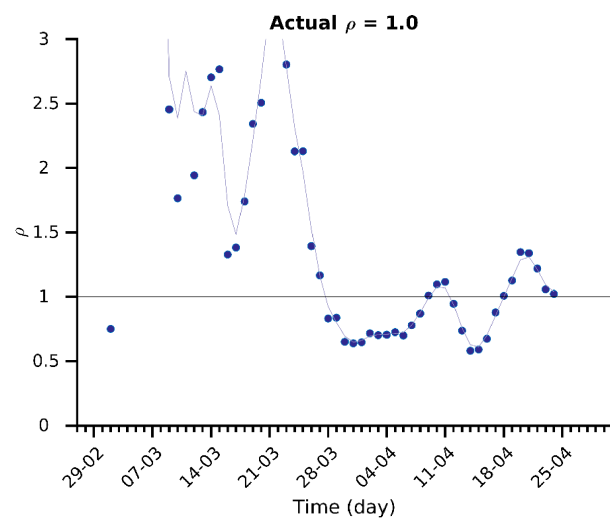
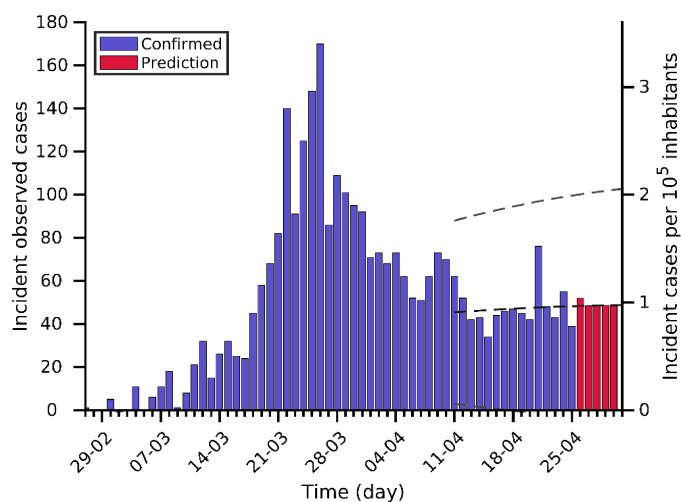
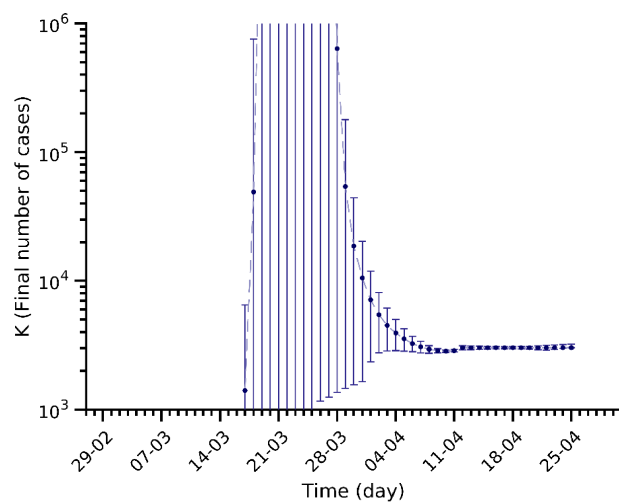
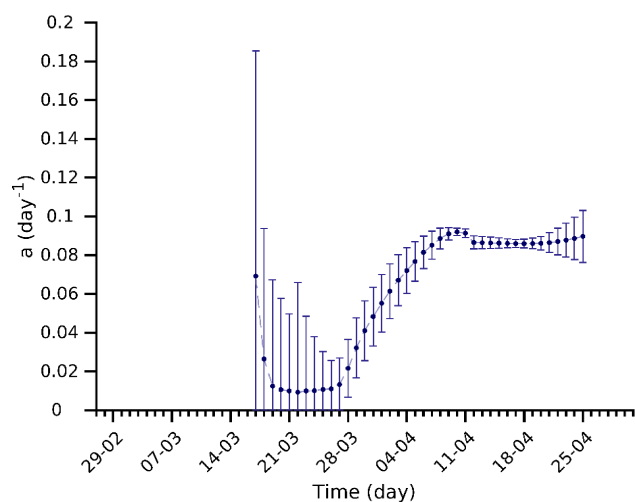
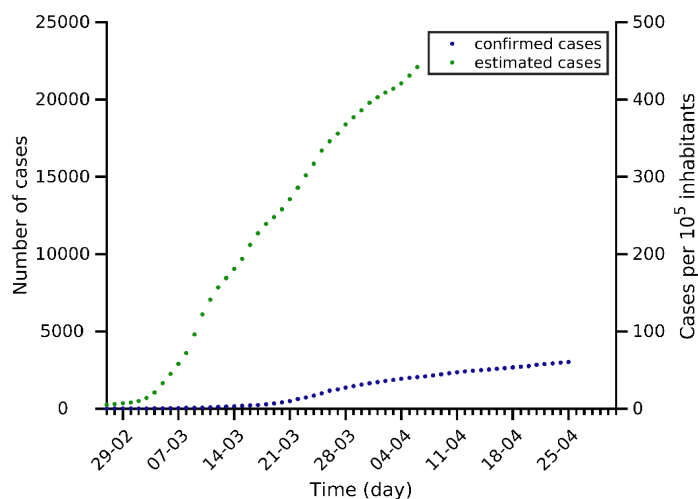
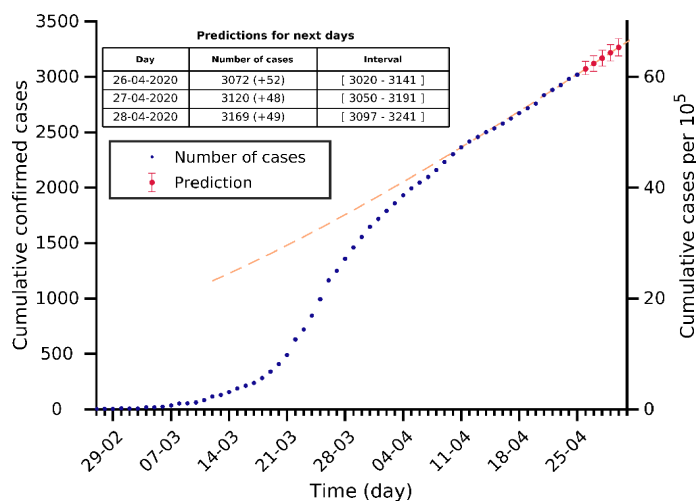
# Puglia 25-04-2020. Population: 4.0M. Current cumulated incidence: 97/10<sup>5</sup>



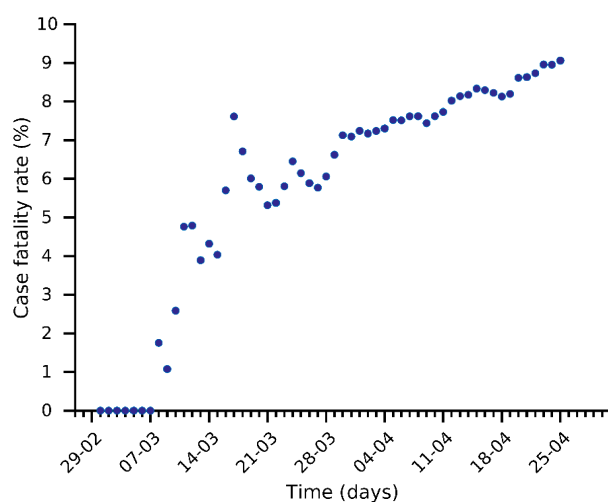
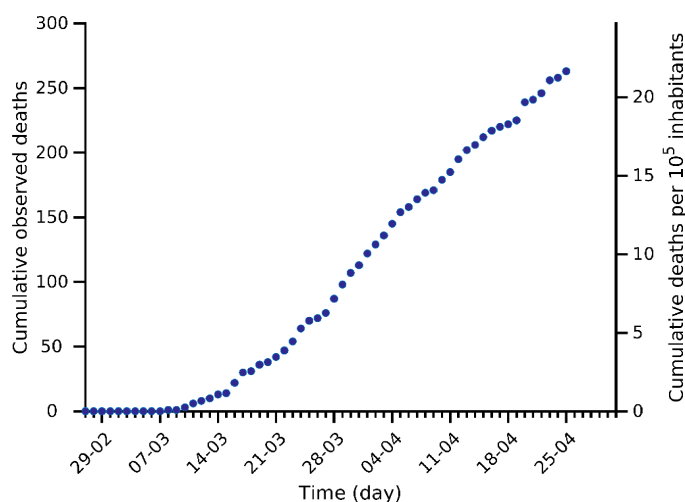
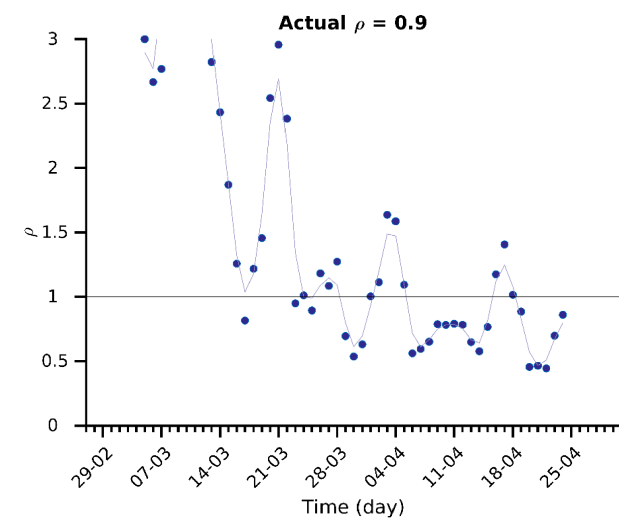
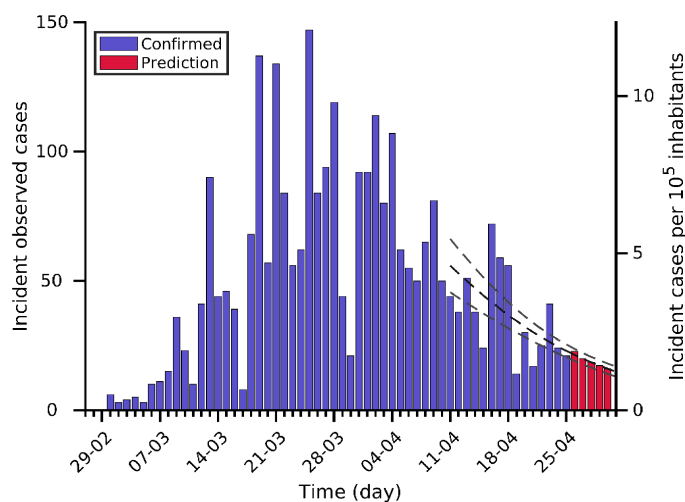
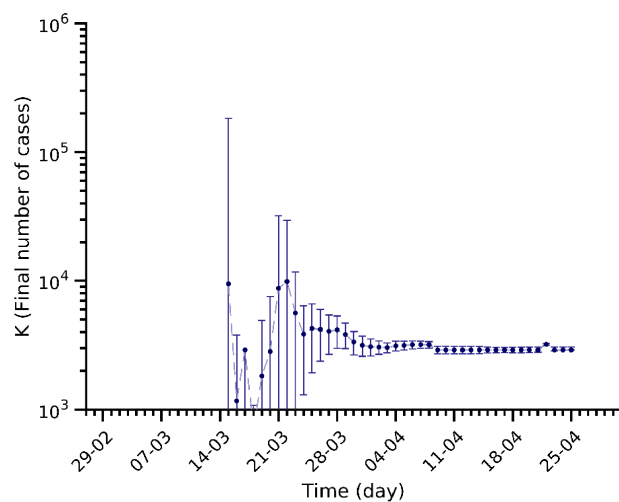
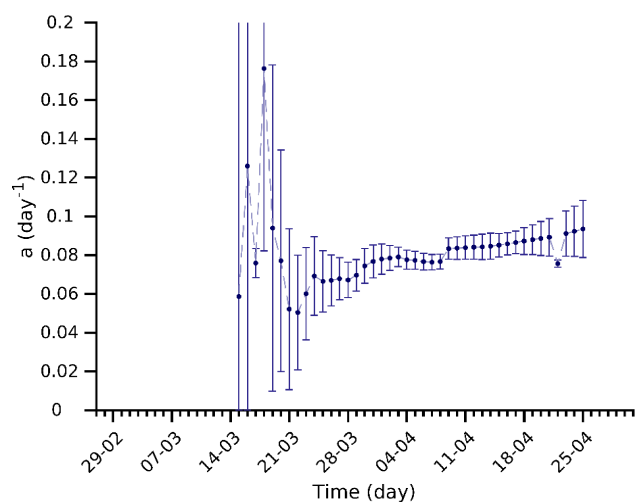
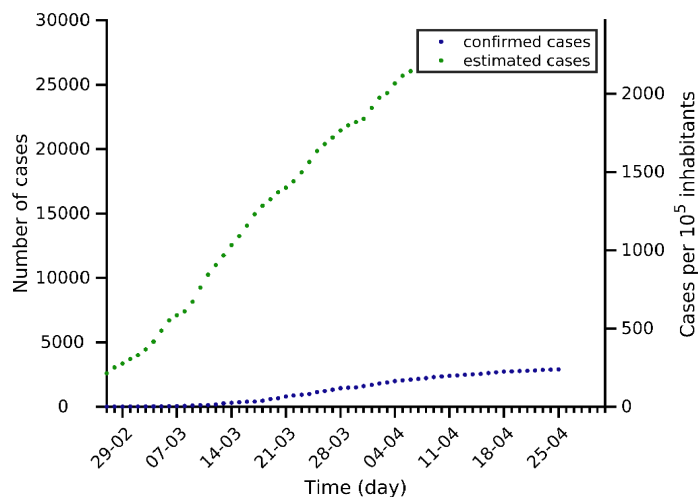
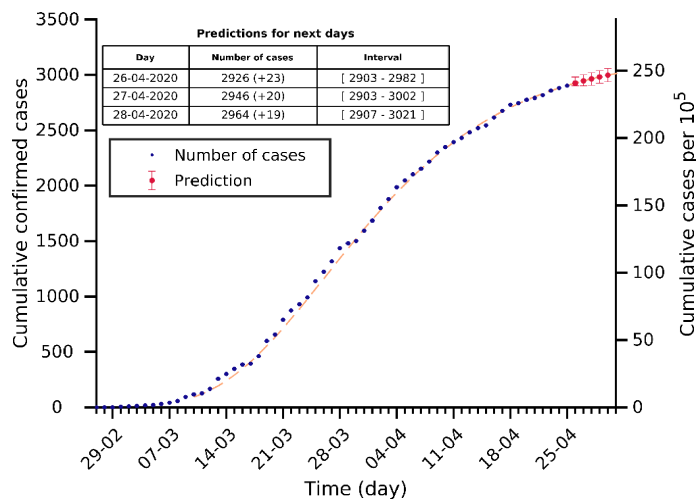
# Trento 25-04-2020. Population: 0.5M. Current cumulated incidence: 713/10<sup>5</sup>



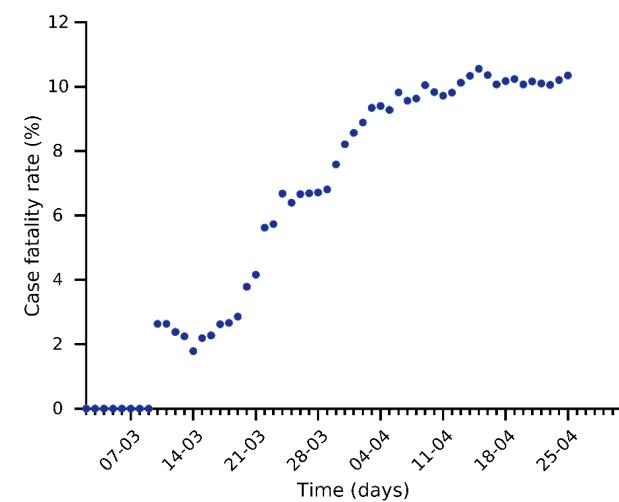
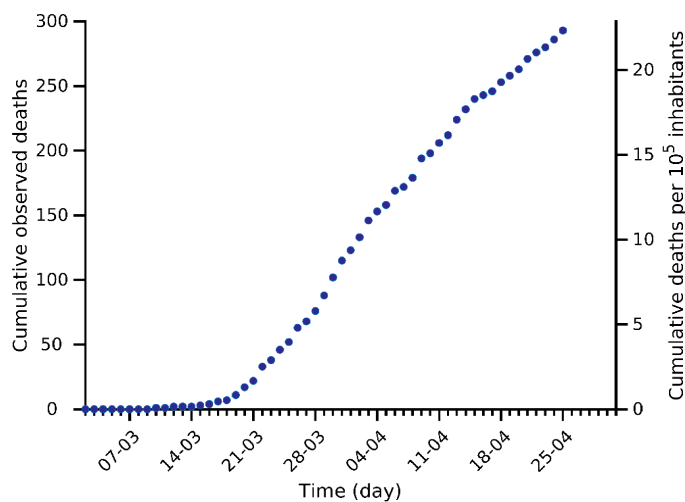
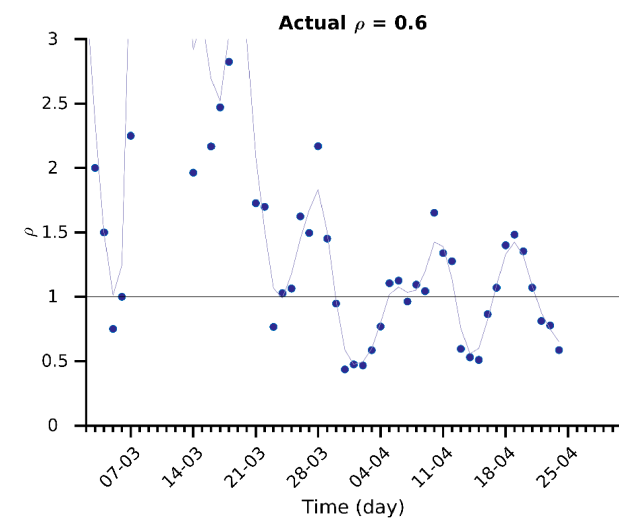
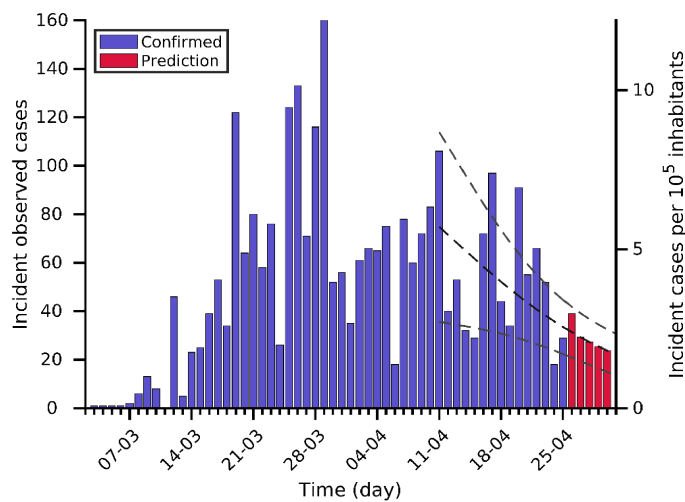
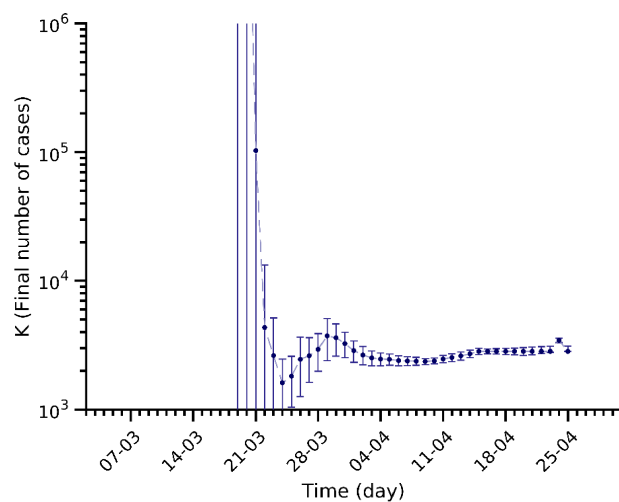
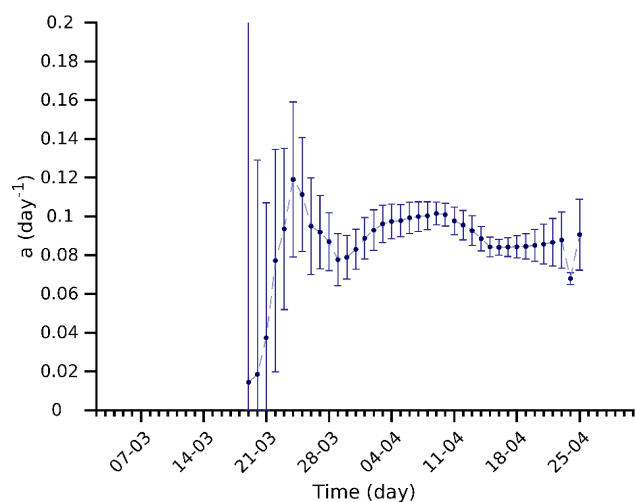
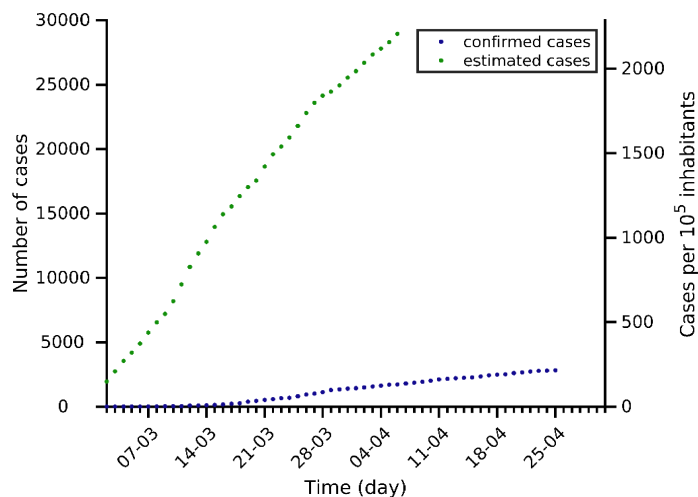
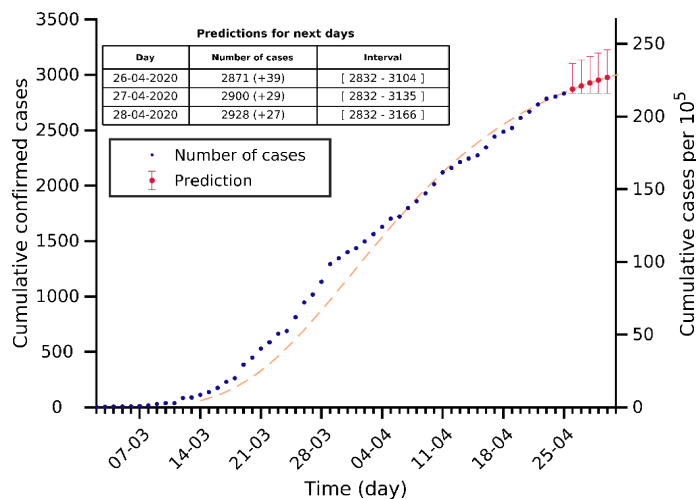
# Sicilia 25-04-2020. Population: 5.0M. Current cumulated incidence: 60/10<sup>5</sup>



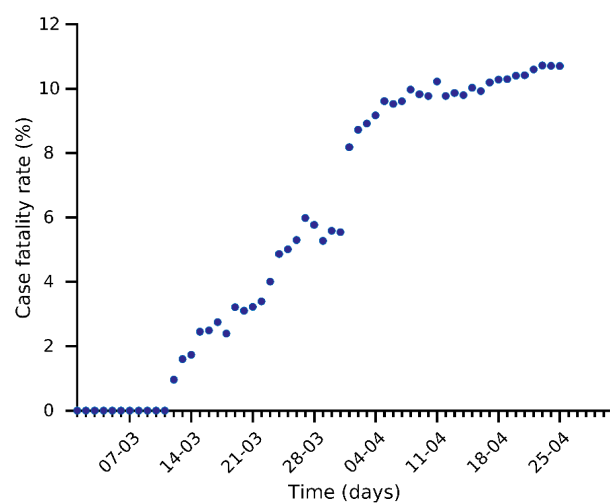
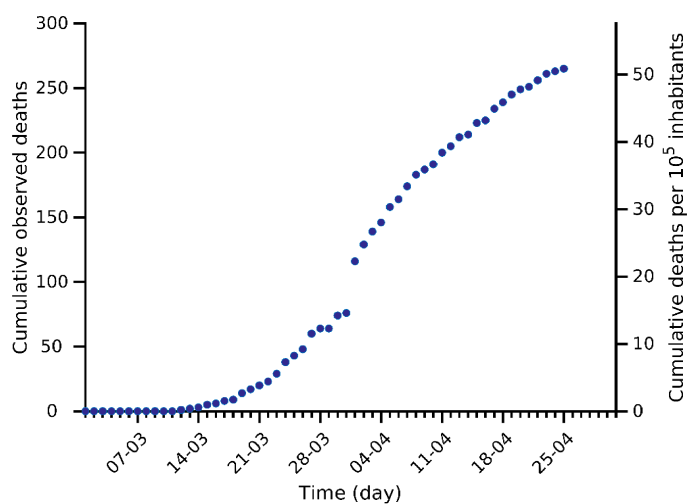
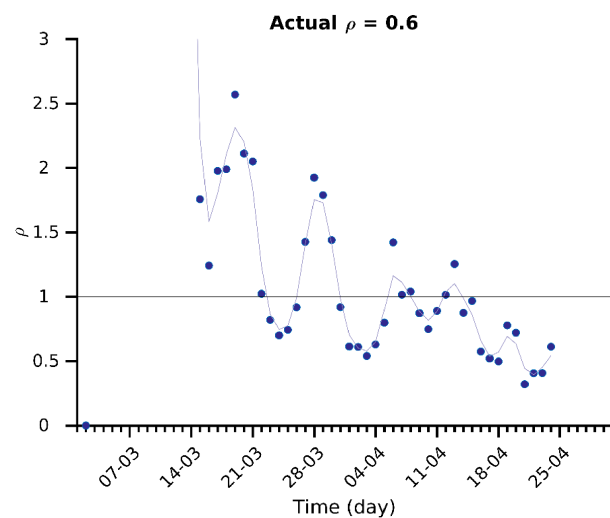
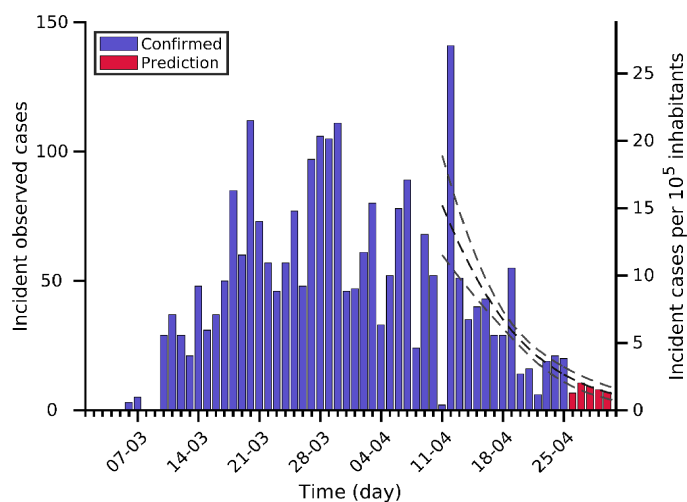
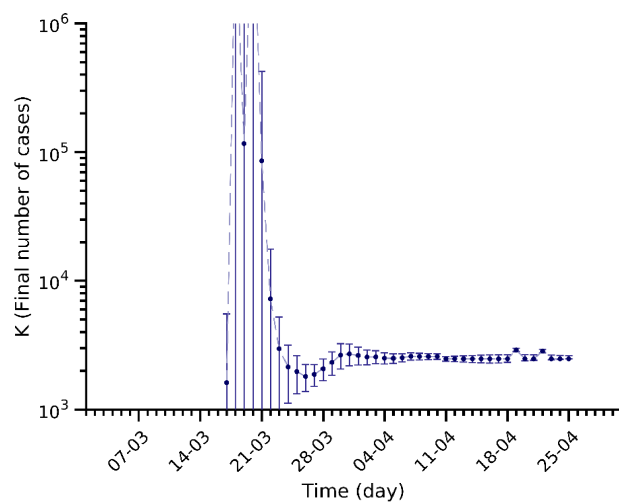
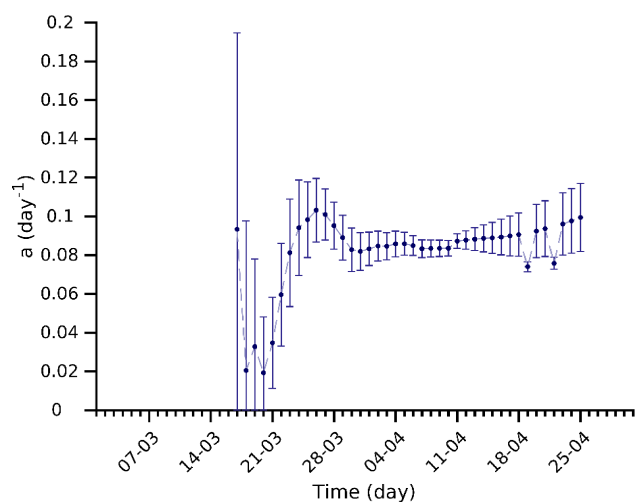
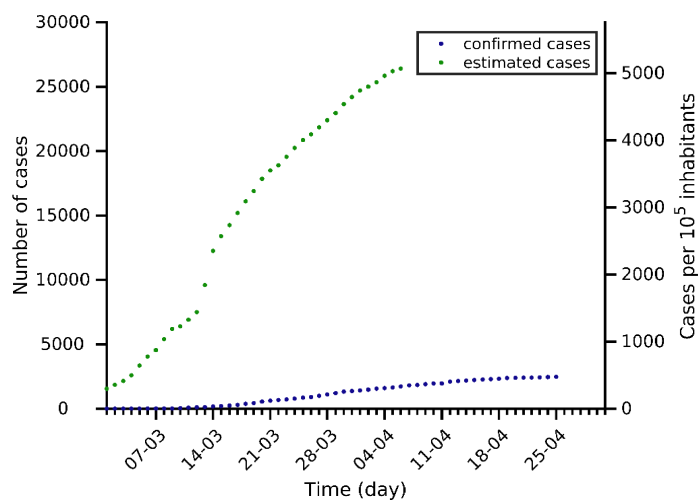
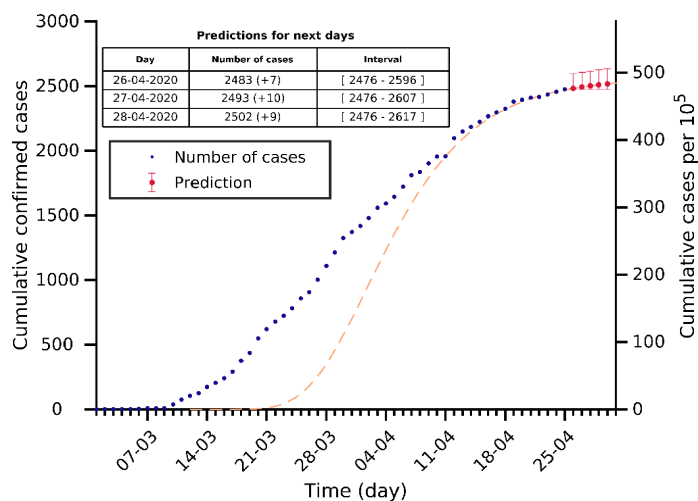
# Friuli Venezia Giulia 25-04-2020. Population: 1.2M. Current cumulated incidence: 2



# Abruzzo 25-04-2020. Population: 1.3M. Current cumulated incidence: 216/10<sup>5</sup>

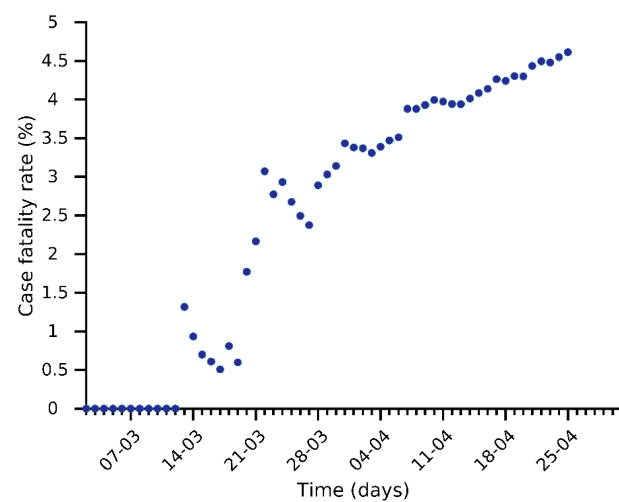
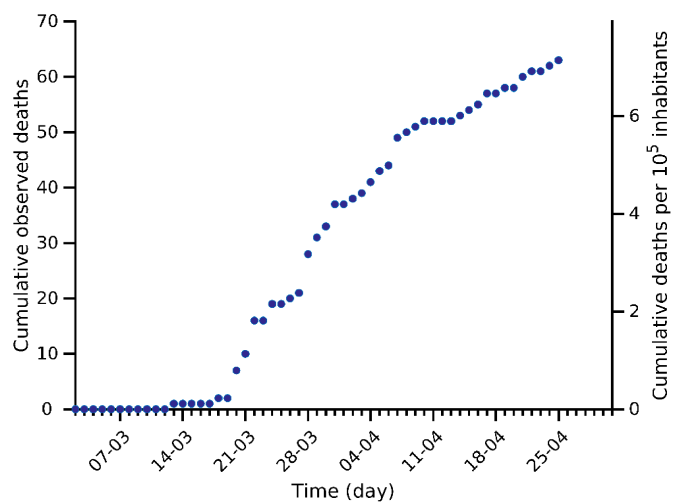
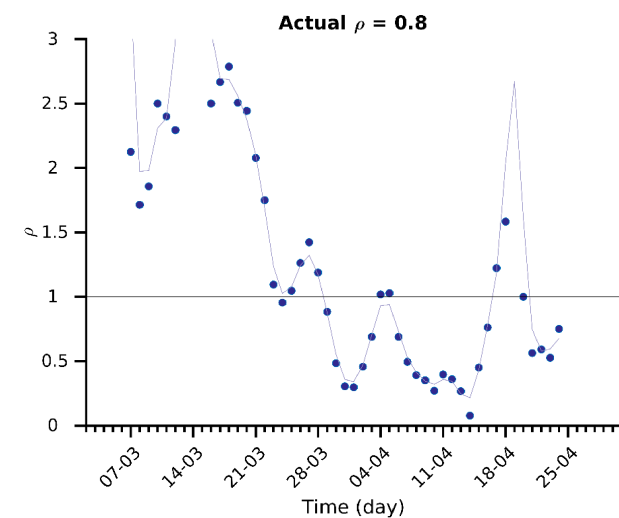
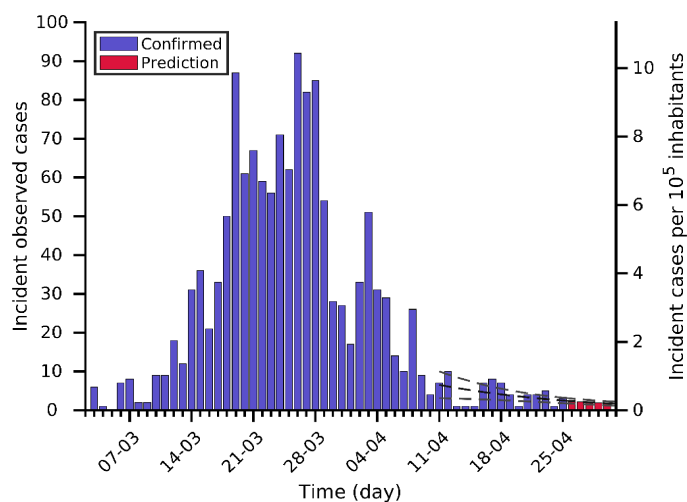
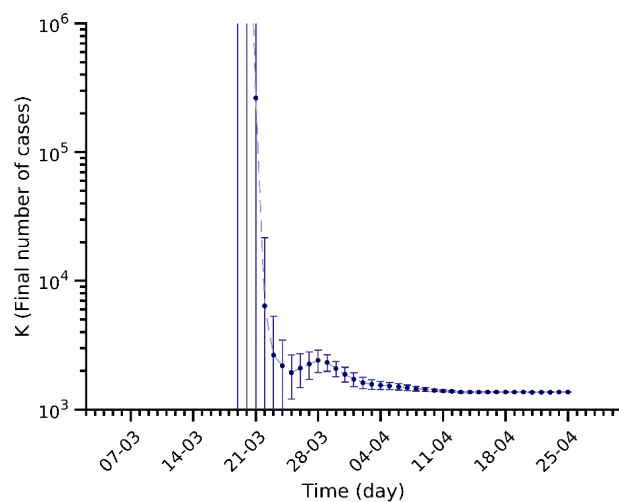
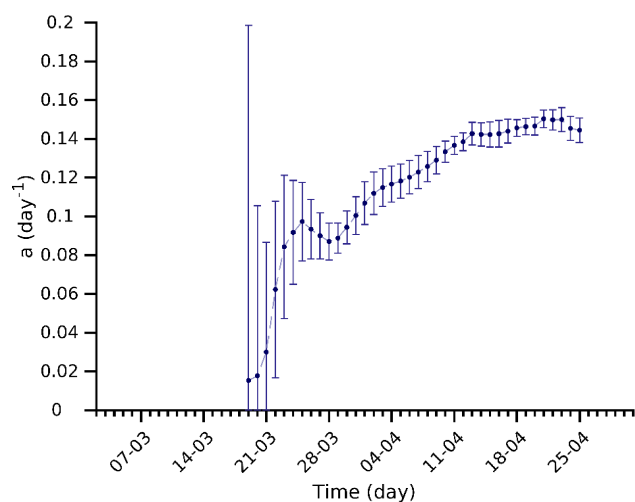
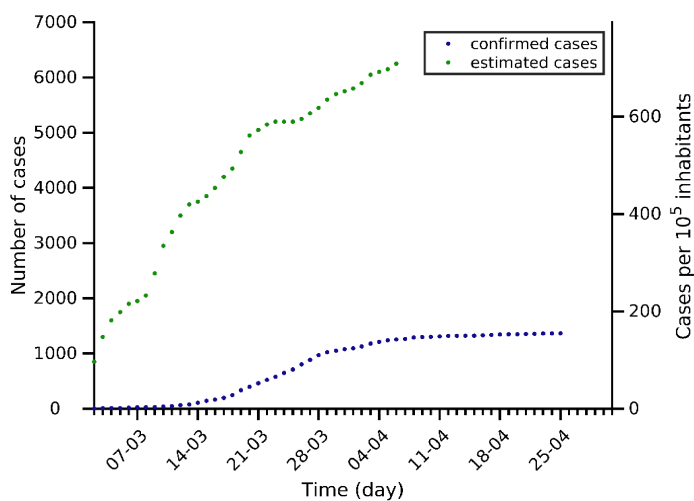
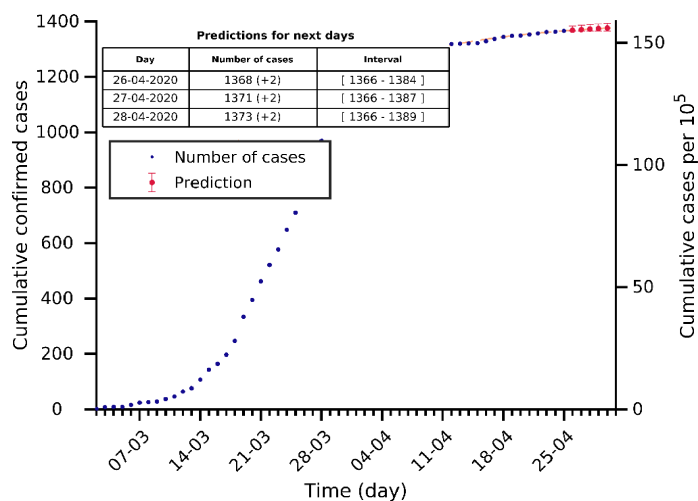


# Bolzano 25-04-2020. Population: 0.5M. Current cumulated incidence: 475/10<sup>5</sup>

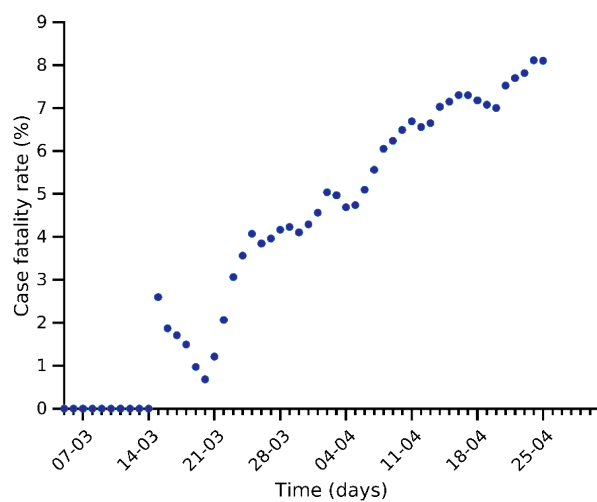
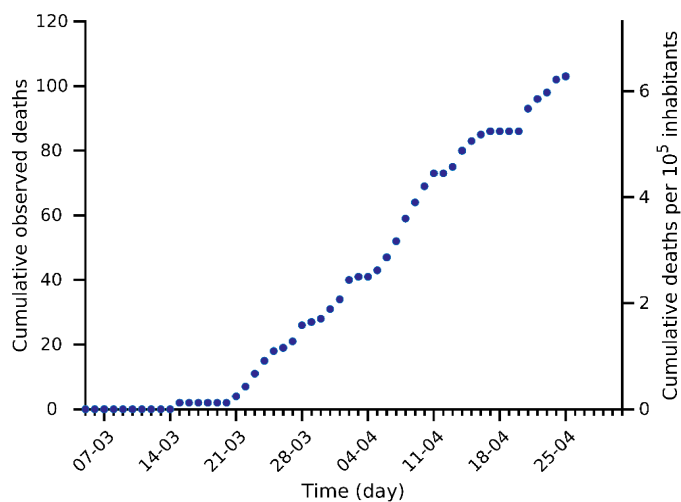
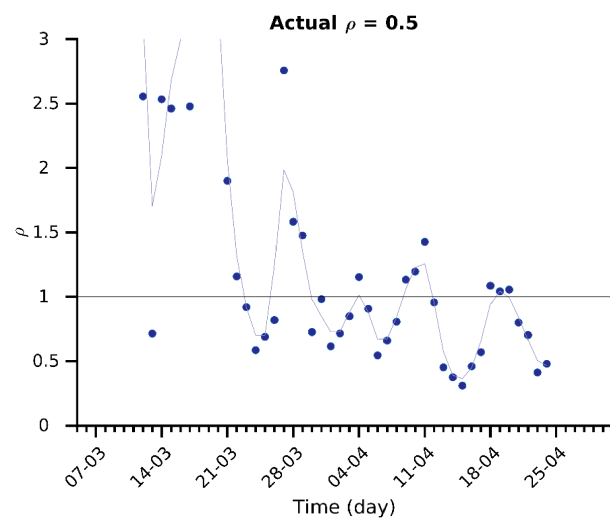
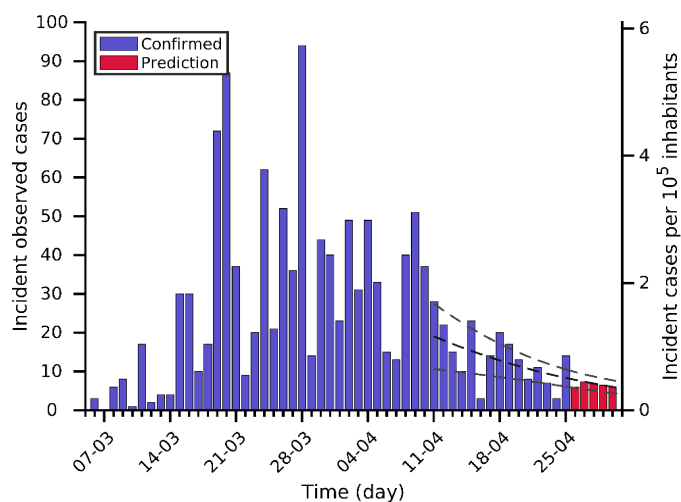
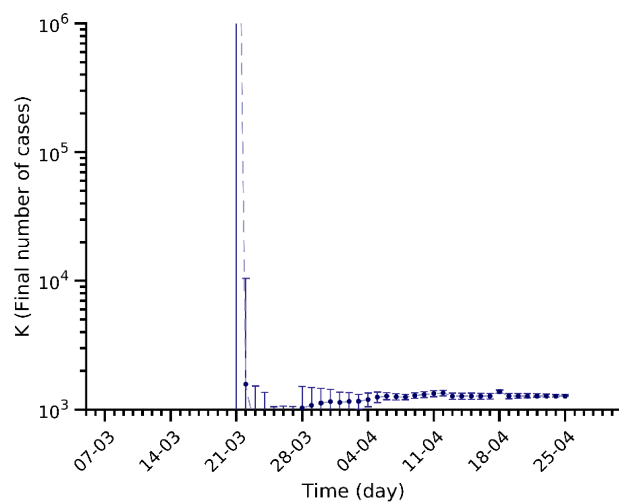
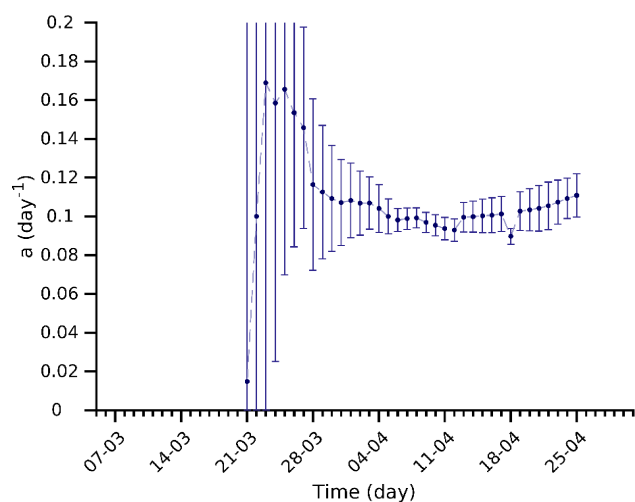
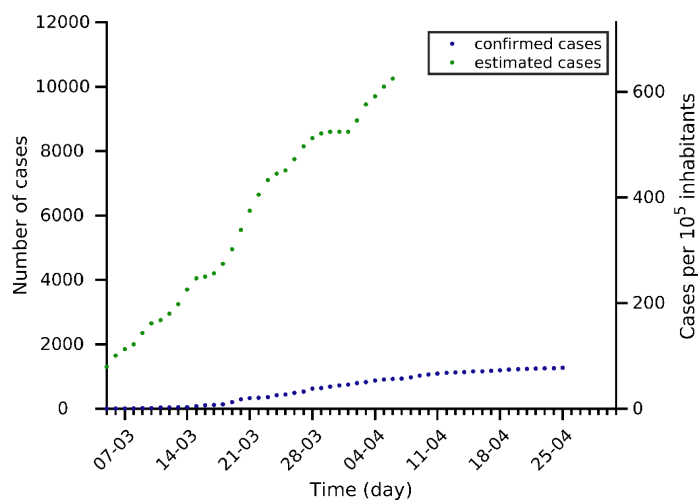
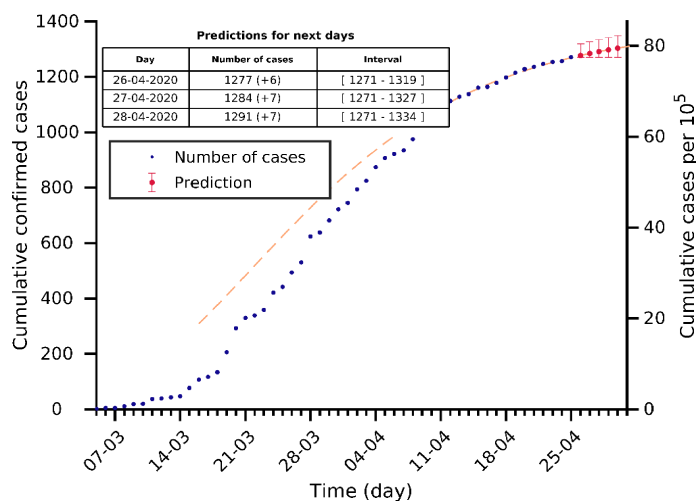




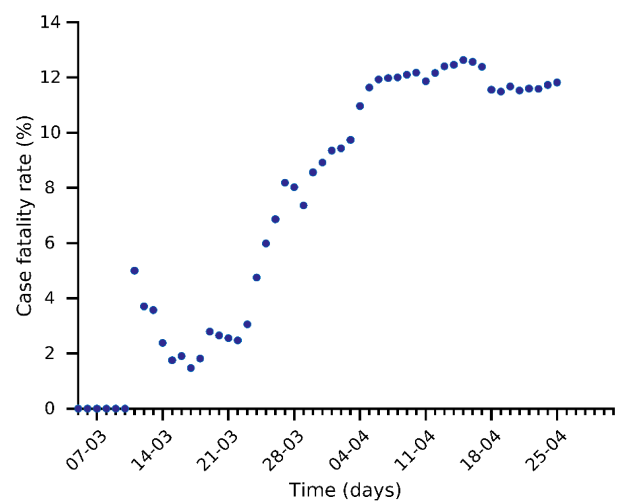
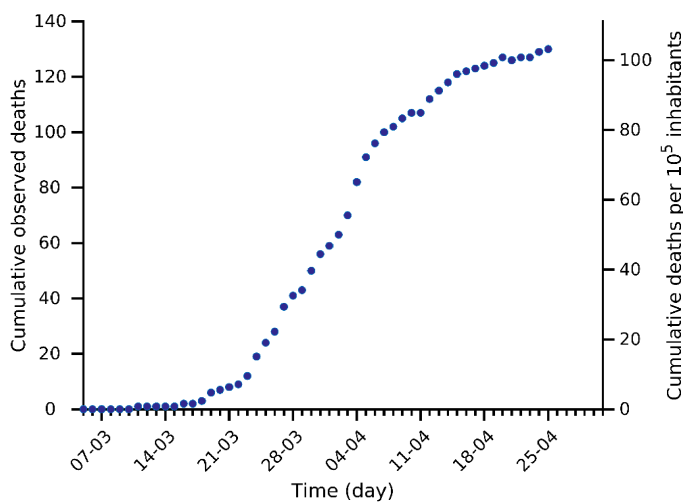
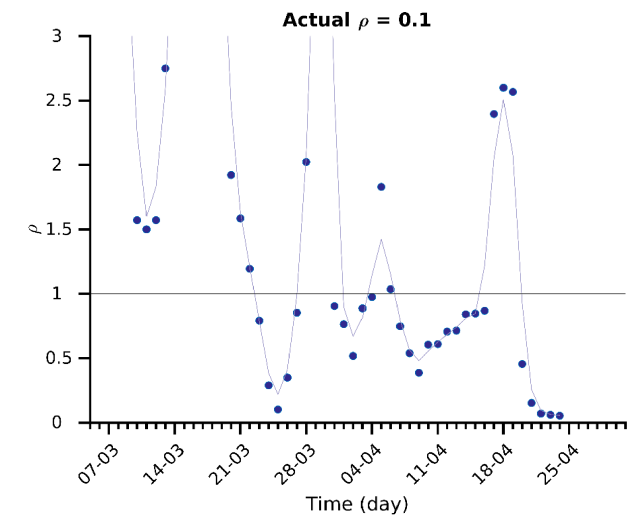
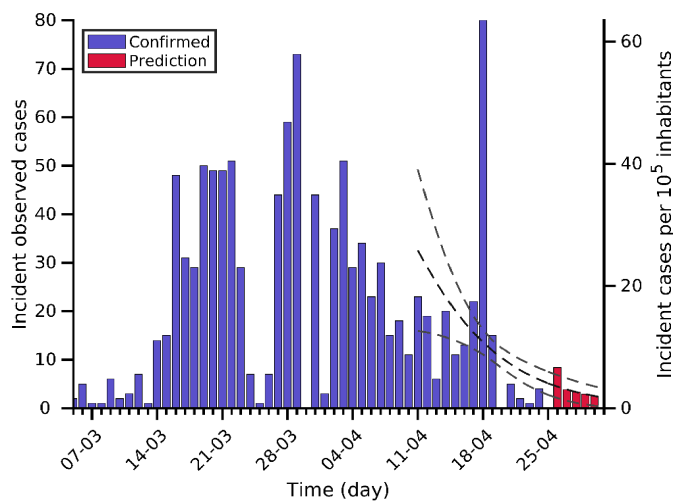
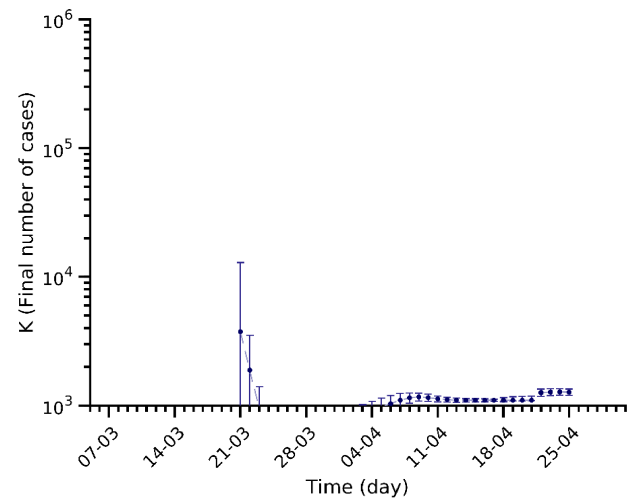
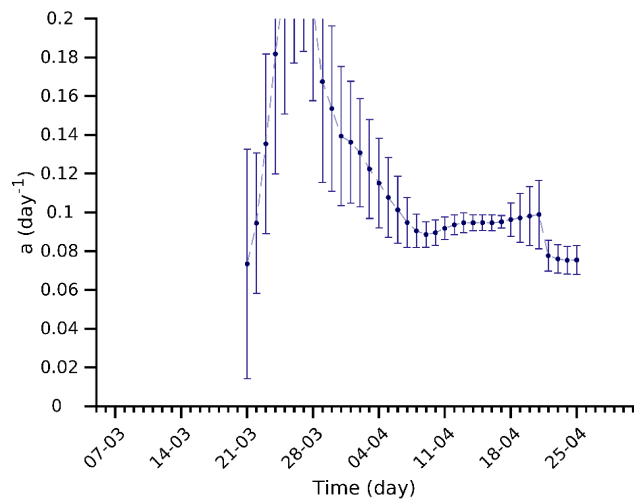
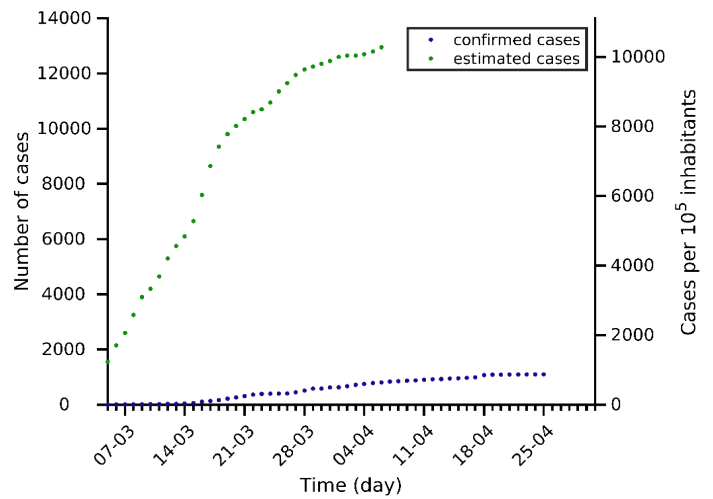
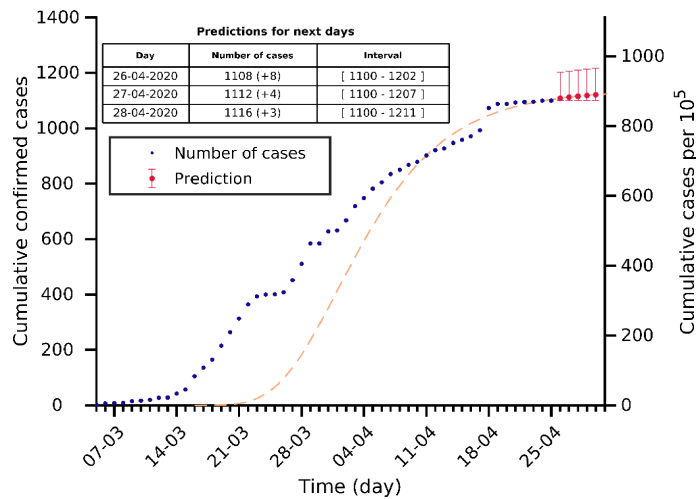
# Umbria 25-04-2020. Population: 0.9M. Current cumulated incidence: 155/10<sup>5</sup>



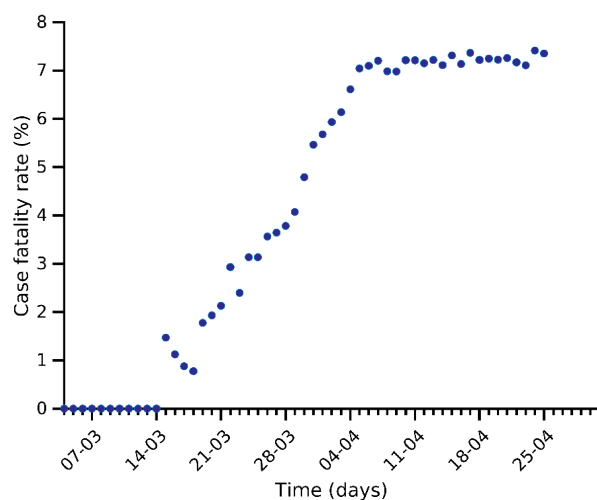
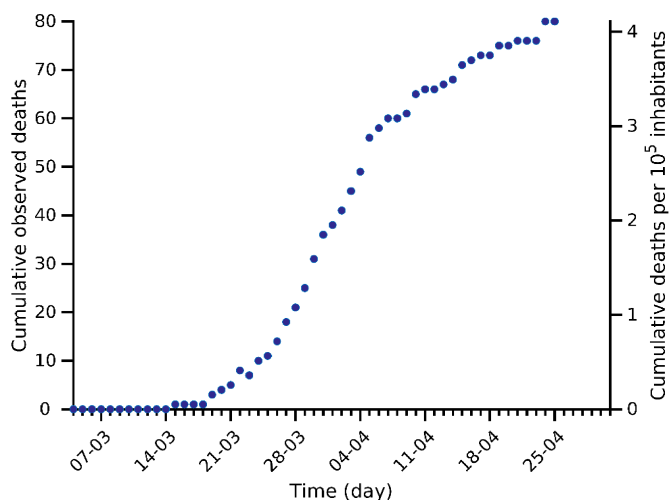
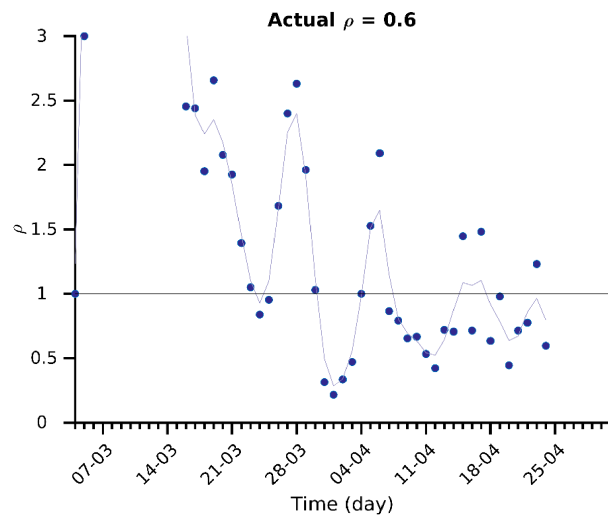
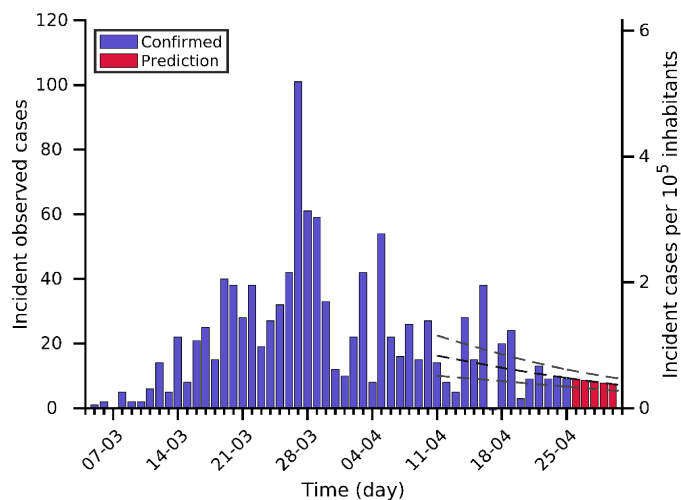
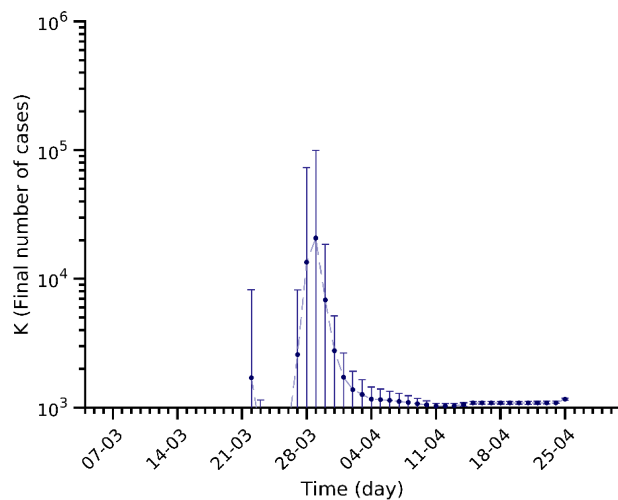
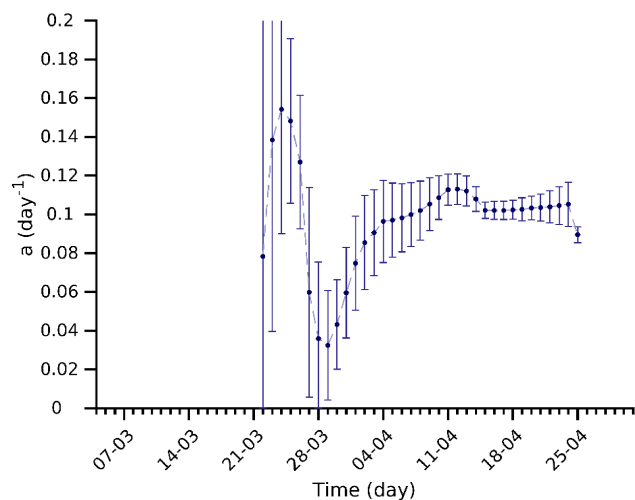
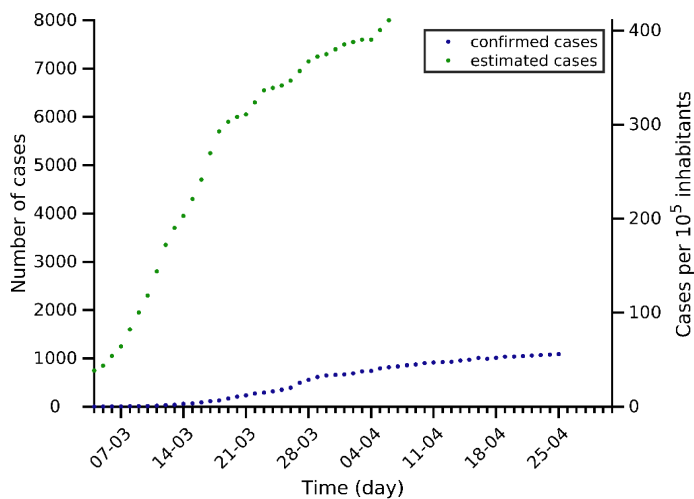
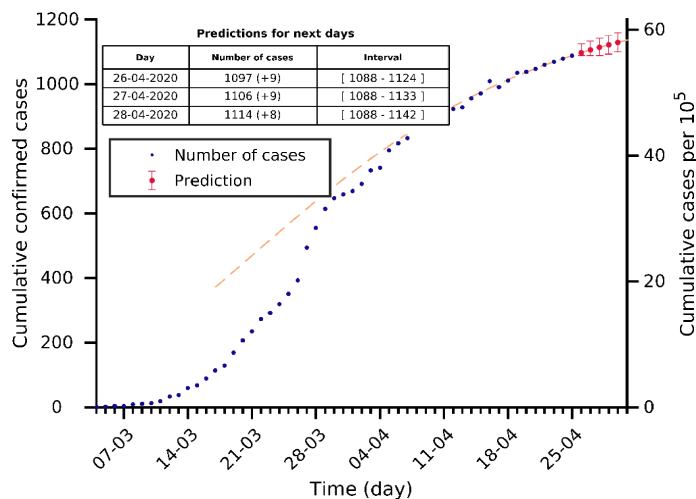
# Sardegna 25-04-2020. Population: 1.6M. Current cumulated incidence: 78/10<sup>5</sup>



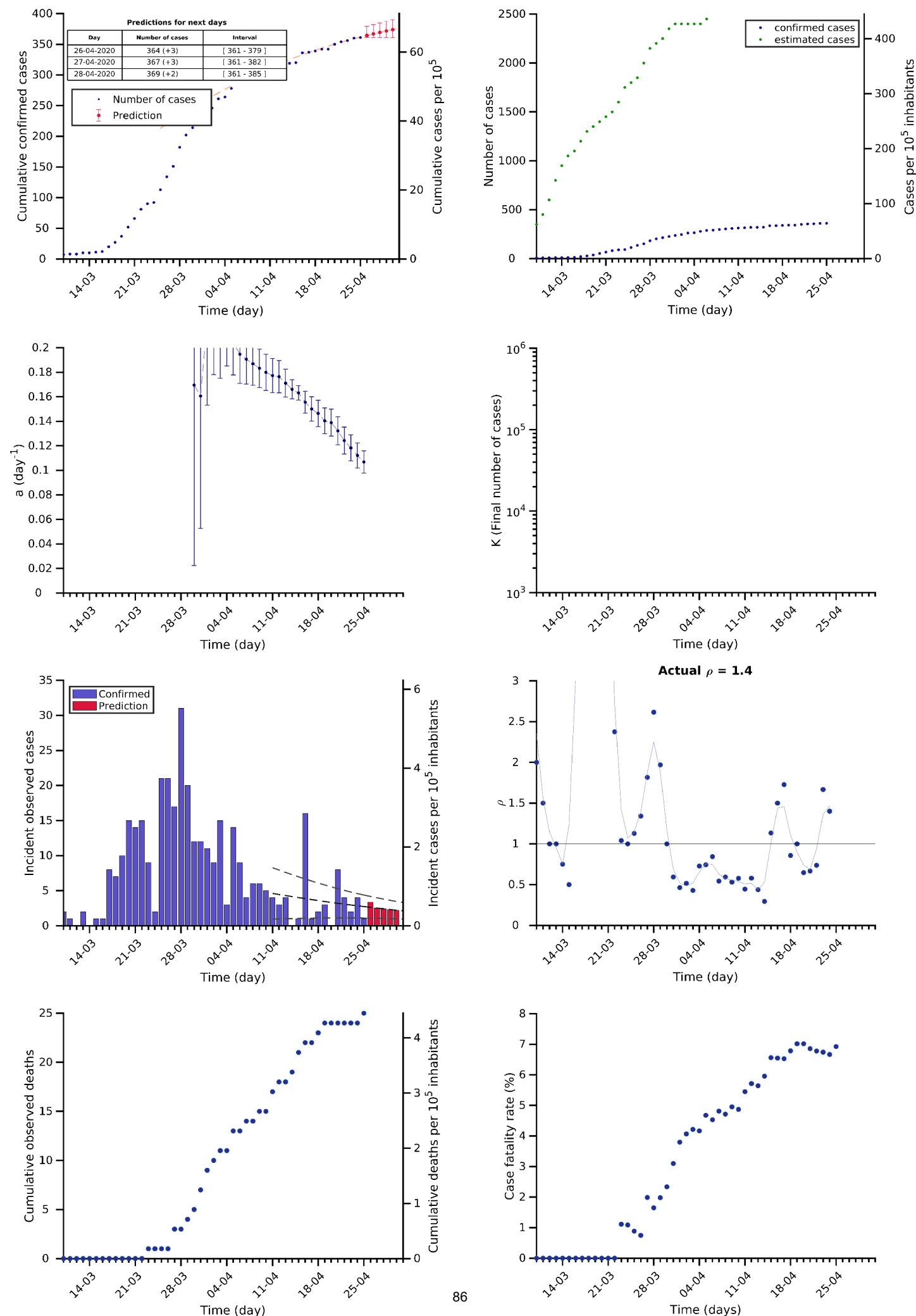
# Valle d'Aosta 25-04-2020. Population: 0.1M. Current cumulated incidence: 873/10<sup>5</sup>



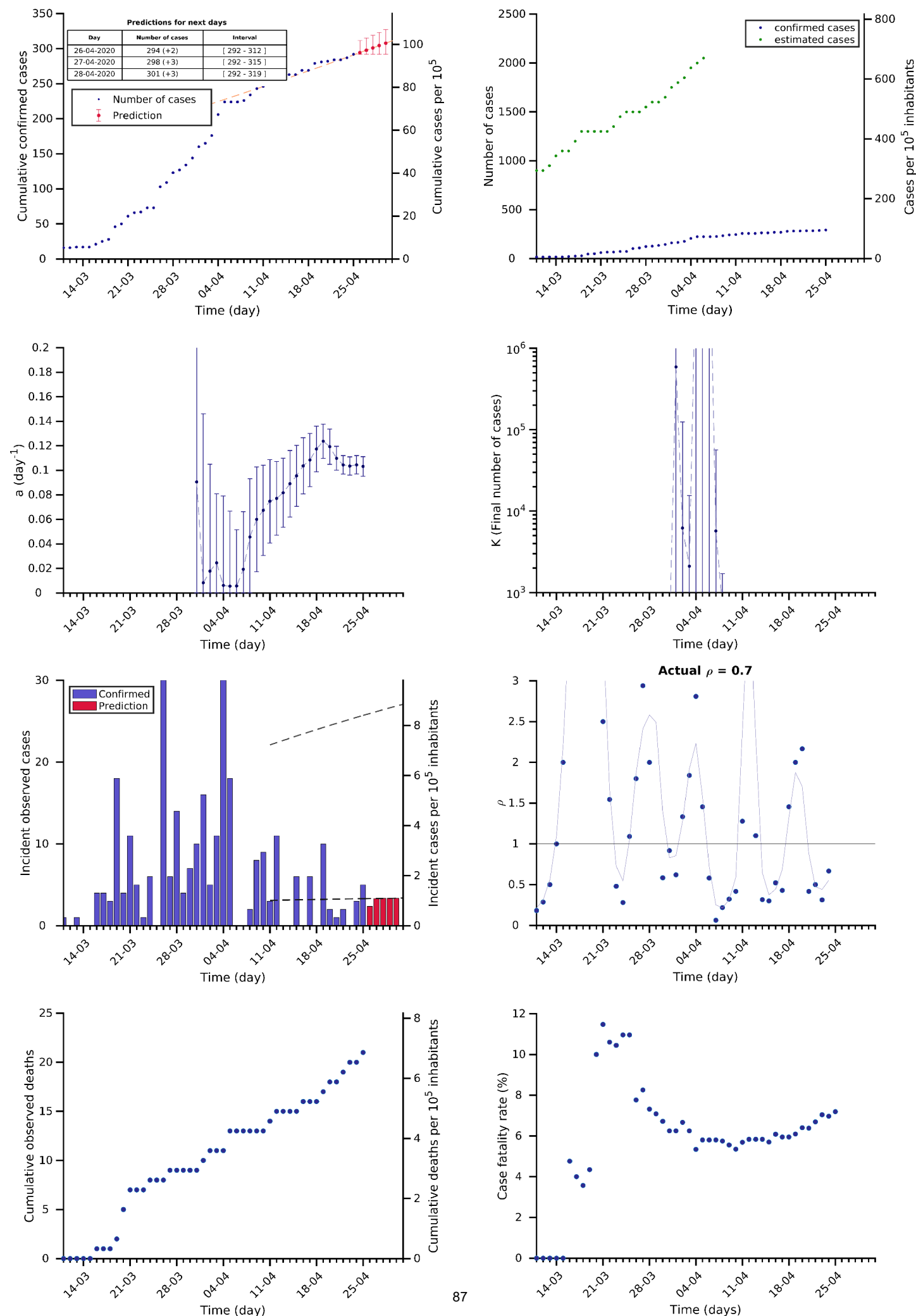
# Calabria 25-04-2020. Population: 1.9M. Current cumulated incidence: 56/10<sup>5</sup>



# Basilicata 25-04-2020. Population: 0.6M. Current cumulated incidence: 64/10<sup>5</sup>



# Molise 25-04-2020. Population: 0.3M. Current cumulated incidence: 95/10<sup>5</sup>



## Methods

## Methods

### **(1) Data source**

Data are daily obtained from World Health Organization (WHO) surveillance reports<sup>1</sup>, from European Centre for Disease Prevention and Control (ECDC)<sup>2</sup> and from Ministerio de Sanidad<sup>3</sup>. These reports are converted into text files that can be processed for subsequent analysis. Daily data comprise, among others: total confirmed cases, total confirmed new cases, total deaths, total new deaths. It must be considered that the report is always providing data from previous day. In the document we use the date at which the datapoint is assumed to belong, i.e., report from 15/03/2020 is giving data from 14/03/2020, the latter being used in the subsequent analysis.

### **(2) Data processing and plotting**

Data are initially processed with Matlab in order to update timeseries, i.e., last datapoints are added to historical sequences. These timeseries are plotted for EU individual countries and for the UE as a whole:

- ✓ Number of cumulated confirmed cases, in blue dots
- ✓ Number of reported new cases
- ✓ Number of cumulated deaths

Then, two indicators are calculated and plotted, too:

- ✓ Number of cumulated deaths divided by the number of cumulated confirmed cases, and reported as a percentage; it is an indirect indicator of the diagnostic level.
- ✓  $\rho$ : this variable is related with the reproduction number, i.e., with the number of new infections caused by a single case. It is evaluated as follows for the day before last report ( $t-1$ ):

$$\rho(t-1) = \frac{N_{new}(t) + N_{new}(t-1) + N_{new}(t-2)}{N_{new}(t-5) + N_{new}(t-6) + N_{new}(t-7)}$$

where  $N_{new}(t)$  is the number of new confirmed cases at day  $t$ .

### **(3) Classification of countries according to their status in the epidemic cycle**

The evolution of confirmed cases shows a biphasic behaviour:

- (I) an initial period where most of the cases are imported;
- (II) a subsequent period where most of new cases occur because of local transmission.

Once in the stage II, mathematical models can be used to track evolutions and predict tendencies. Focusing on countries that are on stage II, we classify them in three groups:

- Group A: countries that have reported more than 100 cumulated cases for 10 consecutive days or more;
- Group B: countries that have reported more than 100 cumulated cases for 7 to 9 consecutive days;
- Group C: countries that have reported more than 100 cumulated cases for 4 to 6 days.

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<sup>1</sup> <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>

<sup>2</sup> <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>

<sup>3</sup> <https://www.mscbs.gob.es/profesionales/saludPublica/ccayes/alertasActual/nCov-China/situacionActual.htm>  
<https://github.com/datadista/datasets/tree/master/COVID%2019>



#### **(4) Fitting a mathematical model to data**

Previous studies have shown that Gompertz model<sup>4</sup> correctly describes the Covid-19 epidemic in all analysed countries. It is an empirical model that starts with an exponential growth but that gradually decreases its specific growth rate. Therefore, it is adequate for describing an epidemic that is characterized by an initial exponential growth but a progressive decrease in spreading velocity provided that appropriate control measures are applied.

Gompertz model is described by the equation:

$$N(t) = K e^{-\ln\left(\frac{K}{N_0}\right) \cdot e^{-a \cdot (t-t_0)}}$$

where  $N(t)$  is the cumulated number of confirmed cases at  $t$  (in days), and  $N_0$  is the number of cumulated cases the day at day  $t_0$ . The model has two parameters:

- ✓  $a$  is the velocity at which specific spreading rate is slowing down;
- ✓  $K$  is the expected final number of cumulated cases at the end of the epidemic.

This model is fitted to reported cumulated cases of the UE and of countries in stage II that accomplish two criteria: 4 or more consecutive days with more than 100 cumulated cases, and at least one datapoint over 200 cases. Day  $t_0$  is chosen as that one at which  $N(t)$  overpasses 100 cases. If more than 15 datapoints that accomplish the stated criteria are available, only the last 15 points are used. The fitting is done using Matlab's Curve Fitting package with Nonlinear Least Squares method, which also provides confidence intervals of fitted parameters ( $a$  and  $K$ ) and the  $R^2$  of the fitting. At the initial stages the dynamics is exponential and  $K$  cannot be correctly evaluated. In fact, at this stage the most relevant parameter is  $a$ . Fitted curves are incorporated to plots of cumulative reported cases with a dashed line. Once a new fitting is done, two plots are added to the country report:

- ✓ Evolution of fitted  $a$  with its error bars, i.e., values obtained on the fitting each day that the analysis has been carried out;
- ✓ Evolution of fitted  $K$  with its error bars, i.e., values obtained on the fitting each day that the analysis has been carried out; if lower error bar indicates a value that is lower than current number of cases, the error bar is truncated.

These plots illustrate the increase in fittings' confidence, as fitted values progressively stabilize around a certain value and error bars get smaller when the number of datapoints increases. In fact, in the case of countries, they are discarded and set as "Not enough data" if  $a > 0.2 \text{ day}^{-1}$ , if  $K > 10^6$  or if the error in  $K$  overpasses  $10^6$ .

It is worth to mention that the simplicity of this model and the lack of previous assumptions about the Covid-19 behaviour make it appropriate for universal use, i.e., it can be fitted to any country independently of its socioeconomic context and control strategy. Then, the model is capable of quantifying the observed dynamics in an objective and standard manner and predicting short-term tendencies.

#### **(5) Using the model for predicting short-term tendencies**

The model is finally used for a short-term prediction of the evolution of the cumulated number of cases. The predictions increase their reliability with the number of datapoints used in the fitting. Therefore, we consider three levels of prediction, depending on the country:

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<sup>4</sup> Madden LV. Quantification of disease progression. Protection Ecology 1980; 2: 159-176.

- Group A: prediction of expected cumulated cases for the following 3-5 days<sup>5</sup>;
- Group B: prediction of expected cumulated cases for the following 2 days;
- Group C: prediction of expected cumulated cases for the following day.

The confidence interval of predictions is assessed with the Matlab function `predint`, with a 99% confidence level. These predictions are shown in the plots as red dots with corresponding error bars, and also gathered in the attached table. For series longer than 9 timepoints, last 3 points are weighted in the fitting so that changes in tendencies are well captured by the model.

### ***(6) Estimating non-diagnosed cases***

Lethality of Covid-19 has been estimated at around 1 % for Republic of Korea and the Diamond Princess cruise. Besides, median duration of viral shedding after Covid-19 onset has been estimated at 18.5 days for non-survivors<sup>6</sup> in a retrospective study in Wuhan. These data allow for an estimation of total number of cases, considering that the number of deaths at certain moment should be about 1 % of total cases 18.5 days before. This is valid for estimating cases of countries at stage II, since in stage I the deaths would be mostly due to the incidence at the country from which they were imported. We establish a threshold of 50 reported cases before starting this estimation.

Reported deaths are passed through a moving average filter of 5 points in order to smooth tendencies. Then, the corresponding number of cases is found assuming the 1 % lethality. Finally, these cases are distributed between 18 and 19 days before each one.

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<sup>5</sup> At this moment we are testing predictions at 4 days for countries with more than 100 cumulated cases for 13-15 consecutive days, and 5 days for 16 or more days.

<sup>6</sup> Zhou et al., 2020. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. The Lancet; March 9, doi: 10.1016/S0140-6736(20)30566-3